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JANUARY

1926

Introduction.

BY SIR HUMPHRY ROLLESTON, BART., K.C.B., M.D.

Physician in Ordinary to His Majesty the King ; Regius Professor of Physic in the University of Cambridge ; President of the Royal College of Physicians.

AMONG the advances which have taken place during the past ten or fifteen years in the science and art of medicine, some of the most striking have been in the methods adopted for the diagnosis of disease. Methods not long ago introduced in a tentative manner for employment in specialized investigations have to-day become ordinary matters of routine eminently applicable in general practice.

The main purpose of these two Special Numbers of THE PRACTITIONER is to familiarize the general practitioner with some of the more important of modern diagnostic methods, and to demonstrate their value in everyday practice, emphasizing the general principles

which should guide the practitioner rather than the details of technique. Owing to postal difficulties, it has been found impossible to include in one number the wide survey of modern methods in diagnosis which the distinguished contributors have presented, and the material has had to be divided into two parts. The February issue will therefore be a continuation of the present one.

Laboratory methods, which make up clinical pathology, supplement the diagnosis made by ordinary bedside examination in several directions, just as the microscope or the telescope increases the ordinary man's powers of observation. Physical signs, though they do not provide all the information to be derived from ordinary clinical examination, deal mainly with the evidence produced by gross structural change, whereas laboratory methods not only may reveal structural changes, such as those in the blood, urine, cerebro-spinal fluid, and gastric secretions, which at best can only be guessed at by the unaided eye, but they may reveal the disorders of function which precede organic change.

Again, laboratory methods, for example, those based on bacteriology and serology, render diagnosis more minutely accurate; thus, what is clinically a case of fever of uncertain origin, probably enteric fever, may be definitely settled by the Widal test to be typhoid fever (due to infection with *Bacillus typhosus*) or paratyphoid A or paratyphoid B fever. Success in specific treatment turns on accurate diagnosis; for example, the laboratory determination of which strain of the infecting micro-organism is present in a case of meningococcal or pneumococcal infection may be of great importance in directing the serological or specific treatment. By the Schick and the Dick tests those susceptible to can be distinguished from those immune to diphtheria and scarlet fever respectively, and treated so as to be artificially protected. The articles

in these two Special Numbers will give many other examples of the help that laboratory methods give in clinical diagnosis and treatment.

There is, perhaps, a certain danger, especially for the recently qualified practitioner, in relying too greatly upon the elaborate equipment possessed by every modern teaching hospital, and amid the difficulties that beset a busy practice he may feel somewhat at a loss without the adjacent bacteriological and bio-chemical laboratories, and all the familiar armamentarium of the hospital. This, we are told, is one of the problems particularly confronting medical practice in America, where the wide spaces of the less inhabited areas so greatly isolate the country doctor from his familiar and, indeed, necessary aids, that in some districts there has been no permanent newcomer to the local medical profession for fifteen or twenty years.

Important and necessary, however, as modern histological, hæmatological, bacteriological, and chemical examinations undoubtedly are in medicine, we must not over-estimate them or imagine that they make the older clinical methods of examination superfluous. Laboratory investigation must go hand in hand with the ordinary direct clinical examination of the patient, and the functions of the clinical laboratory should be looked upon as accessory ones, even although the laboratory data may have in many cases a more definite value than the physical signs in arriving at a successful solution of the clinical problem.

Careful history-taking and a thorough physical examination, with the exhibition of a due proportion of clinical acumen and common sense, will, on the whole, serve the practitioner better than much laboratory lore. But the ideal is a critical judgment founded on the combined information supplied by the two methods, each serving as a supplement and check to the other.

Some Pitfalls in Surgical Diagnosis.

By SIR HERBERT F. WATERHOUSE, M.D., F.R.C.S.
Consulting Surgeon to Charing Cross Hospital.

IT would be impossible, in the space available, to discuss all the pitfalls that may lie in wait for the practitioner in surgical diagnosis. I think, therefore, that it might be of most service were I to refer to five conditions which have proved, in my experience, sources of error in diagnosis to able practitioners.

Acute Osteomyelitis.—This grave disease is, without question, that common surgical condition in which diagnosis is most frequently not made until irreparable damage has been done, and limb, or even life, endangered by the delay. Acute osteomyelitis is a disease that has always greatly interested me since, in 1888–1889, I produced it artificially, when working at the University of Göttingen, under the supervision of the late Professor Orth, by injecting pyogenic microbes into the veins of the ear in animals, and causing minor injuries to the bones. I have also seen, in the course of more than thirty years' practice on the staff of a children's hospital, a large number of examples of the disease.

Acute osteomyelitis presents itself in two types: (1) The ultra-acute type caused by the virulent staphylococcus aureus; and (2) the type, less violent in its onset, caused by *Staphylococcus albus*, streptococcus, pneumococcus, *Bacillus coli*, *Bacillus typhosus*, etc. The former type ought always to be diagnosed at the onset, because the symptoms are definite and unmistakable. In the latter type an error in diagnosis

is much more pardonable. In the severe cases the initial symptoms will be a sudden rise of temperature to 103° or 104° Fah., often a rigor, intense toxæmia, vomiting, headache, and even delirium. In the milder cases the temperature may, at first, only be raised a degree, the constitutional symptoms may be scarcely noticeable, and in the case of the lower limb, the patient may be able to walk a short distance without much complaint of pain. It is in these cases that a diagnosis of osteomyelitis presents extreme difficulty. Let me mention two typical examples of the disease:

Case 1.—A little girl of 10 years of age, seen with Dr. A. A. Greenwood. The history given me was that the child had a rigor about mid-day and complained of intense pain in the lower end of the tibia. I saw her at 10 p.m., the temperature was then 104°, the pulse rate 138, and the child was evidently extremely ill. The slightest movement of the limb was painful, and pressing on the lower end of the tibia produced intense agony. Two openings were made by a small trephine into the medullary cavity of the lower end of the tibia and the blood that exuded swarmed with the staphylococcus aureus. Recovery was rapid and no necrosis followed. It will be seen that, owing to Dr. Greenwood's sound judgment, the bone was opened ten hours after the first symptoms of the disease.

Case 2.—In marked contrast stands the following case. A boy, 13 years of age, was brought to me by an experienced practitioner. He had received a kick on the head of the tibia some days previously. He complained of some pain two days prior to consulting me, but had gone to the pantomime the previous evening and had slept fairly well during the night. When I saw him with his doctor, his temperature was 99·8°, his pulse rate 88, and he had slight tenderness on deep pressure over the upper end of the tibia, but he had walked from his house to the omnibus, and from the omnibus to my house, more than three-quarters of a mile in all, without complaint. I confess that I failed to diagnose osteomyelitis and that my failure to do so was a grievous one for the boy. Four days later I was called to operate upon him. He had then a subperiosteal abscess with pus in the medulla. Five days after the operation he had osteomyelitis of the lower end of the femur of the opposite side and a week later osteomyelitis of the left parietal bone. Sequestra separated from all his bone lesions and prolonged suppuration endangered his life for many months. The causal agent in this instance was the staphylococcus albus, and, as is so frequently noticed in such cases, it seemed to gain in virulence as time went on.

Two common errors regarding acute osteomyelitis deserve mention. It is generally considered that acute

osteomyelitis in an adult is always of the relapsing variety, i.e. that it is a recrudescence of the disease starting in childhood. This is quite incorrect. Not long ago I saw, in one week, two instances of primary acute osteomyelitis in adults :

(1) With Dr. Jubb, involving the whole of the shaft of the humerus, in a lady of thirty years, resulting from a boil ; (2) with Dr. Blucke, involving the shaft of the femur, in a man aged fifty years (in this instance the pneumococcus was the causal agent).

In cases originating in adult age it is noteworthy that the disease more frequently starts about the middle of the shaft of a long bone, and not, as in children, at one end of the diaphysis. These cases in adults are almost invariably missed in diagnosis until pus reaches the periosteum.

The second common error regarding the disease is that it only occurs in the long bones. No bone in the body is exempt. I have not infrequently found it in the ilium, the scapula, the flat bones of the skull, the sternum, and the os calcis. In one interesting case, seen with Dr. Cockburn, osteomyelitis of the eleventh rib of the right side, by irritating the eleventh intercostal nerve, produced a lump of contracted muscle which closely simulated an abscess due to appendicitis. I have frequently noticed acute osteomyelitis follow a boil, an infection of the fingers, tonsillitis and pharyngitis; but it is an extraordinary fact that osteomyelitis almost always occurs, not during the acute stage of the predisposing condition, but after it has subsided and is nearly forgotten. Thus, in three instances in which acute osteomyelitis followed a boil an interval of about three weeks elapsed between the boil and its serious sequence.

An important point to bear in mind is that in osteomyelitis the inflammation arising in the marrow—i.e. being deeply situated in the bone—frequently presents no signs of its presence except tenderness on *deep*

pressure. I am certain that the real reason for the condition being so frequently missed in its early stages, is that the practitioner expects to find the cardinal signs of inflammation present, viz. heat, redness, swelling, and pain. In the early, i.e. the easily curable, stage of osteomyelitis there is no local heat, no redness, and no swelling. Pain will be present, but varies in intensity in different instances, and may, in cases not due to the *Staphylococcus aureus*, be almost negligible. I venture to stress this absence of the ordinary signs of inflammation because I have so frequently heard practitioners say: "How could I have diagnosed acute osteomyelitis when there was no local heat, no redness of the skin, no swelling, and but little pain." Here you have the explanation of the failure to institute timely surgical intervention.

Of course, the signs of inflammation will be present when the pus has exuded through the bone and has invaded the soft parts, but by this time necrosis will have occurred, and surgical aid will have been summoned too late. It is always a source of wonder to me how osteomyelitis is so frequently mistaken for acute rheumatism of the neighbouring joint. There is no effusion into the joint (early in osteomyelitis), there is no superficial tenderness over the articulation as in inflammation of the joint, and the tenderness is either above or below the joint, not in the joint itself. The diagnosis should always be made within 24 to 36 hours, if necrosis is to be prevented. Of course, the microbes are always brought to the bone by the blood stream, but more often than not the atrium of infection is not discovered.

If I am asked on what grounds the diagnosis of acute osteomyelitis is generally made, I would say a sudden rise of temperature, possibly a rigor, a feeling of malaise, a pain, which at first need not be severe, in a long bone just above or below a joint and, far more important,

marked tenderness on firm, deep, and prolonged pressure over the site of the pain.

These are all the signs that one usually meets with and they must suffice. It is dangerous to wait for further confirmation of the diagnosis. Given such signs it is the bounden duty of the medical attendant to have one or more openings made into the bone right down into the medullary cavity to relieve the tension and to save necrosis. Delay means rapid extension of the inflammation, necrosis, and dire danger. Early relief to the tension ensures speedy recovery with undamaged limb. I would say "don't wait for a surgeon," but, *faute de mieux*, take a gimlet or drill from a carpenter's tool-chest and, after boiling it, drill two or three holes into the bone yourself. It cannot too clearly be stated that, if pus be present and ooze slowly through the drill-holes, the operation has been performed too late. Do not expect pus to rush out when you open the bone. In the soft parts pus can gush out when an abscess is opened, because the walls of the abscess collapse. This, of course, cannot occur in the case of a bone.

It should be remembered that, in a case of osteomyelitis, the bone ought to be drilled before pus has had time to form, and when only blood, swarming with staphylococci, or other microbes, oozes out. We ought always to attain this desideratum in the case of a long bone in a child, but I fear that all of us will be liable to error when we encounter a case in a flat bone, or in a small bone, in which cases it is less easy to think of osteomyelitis, and the same applies, even in a long bone, to a primary acute osteomyelitis originating in adults.

Sub-phrenic Abscess.—This dangerous condition, a collection of pus beneath the vault of the diaphragm, is generally missed in diagnosis, because it is never thought of. It is true that, owing to the realization of

the need for immediate operative treatment of appendicitis, and of other abdominal emergencies, sub-phrenic abscess is becoming less frequent, but it still takes a large toll of human life, and is far too often overlooked in diagnosis. I have found it a useful rule to follow that when, any time from two weeks to two months after a septic lesion in the abdominal cavity, a patient who has appeared to be well on the road to recovery develops continuous fever, elevation of pulse-rate and malaise, and no definite cause can be found for the rapid deterioration in health, the possibility of a sub-phrenic abscess should be seriously considered. Applying this rule I have, not infrequently, when discussing a case over the telephone with the medical attendant, said: "Surely this is a sub-phrenic abscess; I will come down prepared to operate," and in the majority of instances my provisional diagnosis has proved correct. In almost every case the practitioner has said: "I never thought of sub-phrenic abscess."

It is generally said that appendicitis causes one-sixth of all sub-phrenic abscesses. In my experience this is far too low a proportion, as more than half of my cases have owed their origin to lesions of the appendix vermiformis. Probably next in order of frequency among the causes comes perforation of an ulcer on the posterior wall of the stomach into the lesser peritoneal sac. In this case the abscess is almost always situated under the left half of the diaphragm in contradistinction to those caused by appendicitis, which are practically invariably on the right side. Let me relate a typical case:

A young farmer, 24 years of age, was operated upon by his medical attendant in a cottage hospital for an abscess due to appendicitis, on the seventh day of his illness. Several ounces of stinking pus were evacuated and a drainage tube was inserted. No attempt was made to remove the appendix. All went well for twenty days and the patient was then told he could go home the

next day. That evening he complained of malaise and the temperature rose, in four days, to 103°, and the pulse rate to 120. He complained of shivering, but had no definite rigor. This state of matters continued for a further five days, the patient emaciating, being bathed in sweat and obviously going downhill rapidly. At this stage I saw the case. The liver dullness was markedly increased. It reached both higher up and lower down than normal. An *X*-ray screen examination showed the dome of the right half of the diaphragm much more elevated than normal and bulging upwards, as if it had been pushed up by a fist in one place instead of having its usual upward curvature. The abscess was drained and the temperature and pulse fell to normal.

This was a simple case to diagnose, but I must admit that the diagnosis of sub-phrenic abscess is often a matter of great difficulty. I would draw attention to the fact that percussion over the abscess is frequently most misleading. If the abscess is overlain with normal lung, percussion will give the normal note. If there be a basal pleural effusion the note will be dull. If the abscess contain gas, as it frequently does, owing to the presence of the *Bacillus coli,* a tympanitic note will be elicited. The abscess may—I am speaking now, of course, of right-sided cases—be above, behind, or in front of the mass of the liver. Further, it may be fairly superficial or deeply-seated. Clearly the presence of a pleural effusion increases the difficulty of diagnosis. More often than not no effusion is present, and the breath sounds, at the base of the lung, are normal. In doubtful cases the absence of any abnormal lung sounds is in favour of the diagnosis of sub-phrenic abscess. Where possible an X-ray examination should always be made use of, as the information a radiogram may afford is often of the greatest value.

In a sub-phrenic abscess, situated immediately above the liver, a marked, localized, upward convexity of the diaphragm will always be observed in the radiogram, whereas, in a basal pleural effusion, especially when purulent, the normal convexity of the right dome of the diaphragm will be diminished,

and may disappear completely, so that the diaphragm becomes horizontal.

An important diagnostic point is that an effusion into the pleural sac caused by pleurisy, pneumonia, and empyema, or pulmonary infarct, starts with dramatic suddenness, with pain in the chest, and real difficulty in breathing, whilst a sub-phrenic abscess takes days to develop, and is painless, certainly at the commencement. Should a pleural effusion be present it should always, in cases of doubt, be examined bacteriologically. If it be found sterile the probability is that it is secondary to a sub-phrenic abscess. Should the abscess contain gas the percussion note, in the absence of any effusion or consolidation of the base of the lung, is quite diagnostic. If a pleural effusion co-exist with a sub-phrenic abscess the diagnosis may be a matter of grave difficulty because, on the right side, the dullness of the liver passes insensibly into that of the effusion in the pleural sac. In a good radiogram a serous effusion may be seen to be much less opaque than the liver mass, but, with an empyema, no difference between the opacities may be distinguishable.

Frequently a definite diagnosis of sub-phrenic abscess can only be made by puncture with a needle of an aspirator; but this may only be done when everything is prepared for the drainage of the abscess if, and when, found. We must never aspirate a sub-phrenic abscess and leave the track of the needle free to drain into the pleural sac or the peritoneal cavity. I have known death thus caused more than once. Further, let me mention that, on three occasions, I have incised and drained a right-sided basal empyema, and then, some days later, as no improvement was manifested, I have operated a second time and found a sub-phrenic abscess. Frequently it is a matter of extreme difficulty to locate a sub-phrenic abscess. In a recent case I operated upon pus was encountered only on the sixth

insertion of the exploring needle.

Right-sided sub-phrenic abscesses have comprised the large majority of my cases. Left-sided sub-phrenic abscesses, however, I have found easier to diagnose, because all of my cases have been due to leakage from a gastric perforation into the lesser peritoneal sac. The practitioner must bear in mind the possibility, I would almost say the probability, of a sub-phrenic abscess in cases in which, any time between two weeks and two months after any septic abdominal condition, the patient, who has hitherto appeared to be making good progress towards recovery, develops a continuous high temperature, a constant quickening of the pulse-rate, and a rapid deterioration of health, for which no obvious cause can be discovered. The mortality of sub-phrenic abscess is high because the condition is so frequently missed in diagnosis. It goes without saying that the sooner the diagnosis is made, and the abscess drained, the better the chances of recovery. There are few more life-saving operations than a timely one for sub-phrenic abscess, and I am convinced that the mortality of the condition is so high because it is so frequently never even thought of at all. The mortality of sub-phrenic abscess would be halved if every practitioner kept the possibility of its existence constantly in mind.

The Period of Reaction after Perforation of a Gastric Ulcer.—I now wish to direct attention to something I consider a real danger in diagnosis, namely, what is termed the "period of reaction after perforation of a gastric ulcer." I may best illustrate my meaning by referring to two striking cases:

CASE 1.—A gentleman, aged 30, consulted the late Sir James Galloway, who diagnosed a gastric ulcer and wished him to enter a nursing home, to be kept under observation and to have a skiagram taken. He left Sir James's house, had a milk and bun lunch, and then went to the Western District Post Office to send a telegram to his

parents. Whilst writing the telegram he fell unconscious from the agony of a gastric perforation. The officials searched him, and finding an appointment card, telephoned Sir James. This was at 2 p.m. I saw the patient at 6 p.m. His temperature and pulse were normal and he was sitting in an armchair saying he felt quite well and wanted to go home. Examination of his abdomen revealed nothing beyond slight rigidity of the abdominal wall over McBurney's point. It was only with the utmost difficulty that Sir James and I persuaded him to allow operative treatment to be carried out. A large perforation of the anterior wall of the stomach was found, and the stomach contents had been directed, by the mesentery, to the right iliac fossa.

CASE 2.—In the second case, seen with Dr. Gurney Thompson, of Tottenham, a newspaper sub-editor, aged 32, perforated an ulcer of the anterior wall of the stomach at 9 a.m. I saw him at 3 p.m. He was then, he said, quite well and must get away to the office immediately after I left. Pulse and temperature were both normal and nothing amiss could be discovered beyond the fact that his respirations were 32 per minute. The patient's account of his collapse and overwhelming pain at the onset of his attack, and Dr. Gurney Thompson's description of the condition in which he found him half an hour later, were unmistakable, and I advised that he be taken to hospital for immediate operation. On my arrival at hospital at 5 p.m., my house surgeon met me with a smile, and said: "Your perforated gastric ulcer man has just walked upstairs and says he feels very fit." In spite of the patient's energetic protest that he was being submitted to an unnecessary operation, his abdomen was opened, the perforation found, and three pints of fluid removed from his peritoneal cavity.

Both the patients made good recoveries, but, had not the history in each case been abundantly clear, I confess I should not have believed it possible that they could have been suffering from such a grave condition, and could not have blamed anyone who had said that they had nothing the matter with them.

These two cases surely teach us that, in some instances of perforation of a gastric ulcer, a wonderful temporary improvement in the symptoms may occur before the graver signs of peritonitis develop, and that this temporary improvement may be very misleading. I admit that such an absence of symptoms as illustrated in the two cases above is unusual, but I cite them as a warning because in no abdominal condition is immediate operation of more vital importance. I

think it would be safe to say that of cases of acute perforation of a gastric ulcer, operated upon within twelve hours of perforation, 90 per cent. recover, whereas of those operated upon after forty-eight hours 90 per cent die.

It sometimes happens that the surgeon, called to an abdominal case, can get no further in diagnosis than that of a very probable perforation of a gastric ulcer. In such a case I would urge immediate operative treatment because my experience has been that, in every instance, the lesion present has been either a perforated gastric ulcer or some condition equally calling for operative treatment. I should mention that in perforation of a duodenal ulcer the period of reaction, to which I have drawn your attention, after a gastric perforation rarely, if ever, shows anything like the same marked temporary amelioration of symptoms that is often noticed after gastric perforations.

Gangrene of Appendix.—I am almost afraid to say a word about appendicitis after the deluge of communications we have had during the past few years. There is, however, one matter to which I wish to refer, namely, the sudden cessation of all symptoms and the extraordinary temporary improvement that may follow gangrene of the appendix. To illustrate my meaning let me mention a typical case.

I was called to a county town to see a medical practitioner who, for two days, had been suffering from appendicitis. I was informed that his temperature was 102·6°, and his pulse rate 116. I was met at the station by his partner and by a physician who told me they were sorry that they had troubled me unnecessarily, as the patient, an hour before my arrival, had suddenly felt quite well, that his pulse and temperature were now practically normal, that he was free from pain, and that he utterly declined to have any operative treatment. To the amazement of the two doctors, I said: "That is an urgent call for an immediate removal of the appendix." Never have I had so great a difficulty in persuading a patient and his medical advisers to consent to operation. They all thought that the noxious material inside the appendix had found its way back into the cæcum (a thing, by the way, I have never known to occur). I

had to insist that a sudden gangrene of the appendix had occurred, and that the patient's life would be in urgent danger were the gangrenous viscus allowed to remain *in situ.* Operation revealed an appendix which was like a piece of chamois leather and which lay, free from adhesions, in the peritoneal cavity.

I have met with many similar cases. My knowledge of this sudden and wonderful cessation of all symptoms in gangrene of the appendix I owe to a—to me—most instructive talk I was privileged to have with that great surgical teacher, the late J. B. Murphy, of Chicago, and I have no doubt that his explanation is the correct one. Murphy, in his terse, vigorous way, said: "(1) The dead appendix ceases to absorb its noxious contents, and, therefore, pulse and temperature fall to normal. (2) The nerves of the appendix are dead and, therefore, pain ceases. (3) Adhesions can only be formed between two living surfaces. The appendix being a dead thing, no adhesions will be formed to it and, therefore, there is the awful danger of diffuse septic peritonitis when the microbes pass through the gangrenous walls of the appendix, or it drops off." Murphy finished thus: "I guess, sir, you can find no fault with that reasoning?" And I guessed that I could not.

Inversion of the Testis.—This is a subject hardly ever mentioned in the surgical text-books, and I shall not be surprised if the majority of practitioners have never even heard of it. Yet it has, I am convinced, a considerable importance. In this condition the testicle is displaced, so that the epididymis is in front, and the body of the testicle behind it. The tunica vaginalis lies posterior to the body of the testis, and a hydrocele will, therefore, have the testis in front of it.

As regards the frequency of inversion, I may mention that I examined 100 adult men and found it present in three instances. My colleague, Dr. Alfred Piney, director of the Institute of Pathology at Charing Cross Hospital, was kind enough, at

my request, to pursue an extended inquiry into the question, and he informs me that in 907 *post-mortem* examinations he has found inversion of the testis twelve times. In no case was the inversion bi-lateral. Under ordinary conditions this displacement is never discovered. Serious danger threatens, however, when a hydrocele is tapped or operated upon in the case of inversion of the testis.

A young medical practitioner, who had just bought a country practice, had, as one of his first patients, the Squire, who had a large hydrocele. Three times my friend plunged the trocar into the front of what he took to be a hydrocele but nothing but blood escaped, and on the third occasion the patient fainted. Hæmotocele quickly resulted, and later suppuration of the testicle. I had to perform castration. My young friend remarked: "I cannot blame myself for not recognizing a condition not mentioned in one of my surgical books."

I confess that I am surprised that Dr. Piney's statistics show that inversion of the testis occurs only in about one man in seventy-five. In my experience injury to the testis in tapping a hydrocele has been a frequent cause of hæmatocele of the tunica vaginalis testis, and in only one of these cases had the testis not been inverted. When the general practitioner has to tap a hydrocele which is not translucent to transmitted light, my advice is to enter the trocar on the outer side of the scrotum, instead of in front. I think it probable that inversion of the testis may predispose to the development of a hydrocele, because I have met with the condition in no fewer than twenty-two patients.

The Value of Modern Laboratory Methods to the General Practitioner.

By SIR FREDERICK W. ANDREWES, M.D., F.R.C.P., F.R.S.
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THE past five and twenty years have witnessed a new development in medicine and surgery. Within the memory of many now living and practising, these subjects were purely clinical; the data required for diagnosis and treatment were derived solely from the trained senses of the observer, aided by a few simple clinical instruments; there was perhaps an occasional appeal to the microscope, and simple chemical tests of the urine were carried out in the ward. The basis of successful practice still depends and must always depend upon thorough physical examination of the patient, but the progress of modern pathology has revealed a host of changes in the diseased body which can be detected only by laboratory methods requiring a special training.

Investigations of this sort can be employed to supplement and reinforce the data gained from purely clinical observation, and thus has arisen a new branch of study—clinical pathology—which is growing yearly in its scope. It has proved of such value that every large hospital has long been compelled to possess and equip clinical laboratories manned by trained workers in histology, hæmatology, bacteriology, and bio-chemistry.

The student, during his curriculum, is obliged to gain some practical acquaintance with the methods

of clinical pathology, and their utility in practice is daily brought home to him at the bedside. It is not too much to say that were a modern clinician suddenly to be deprived of these new aids to his work, he would feel almost as if he had lost one of his special senses.

Now this deprivation is one of the things that is in danger of happening to the qualified man when he embarks on general practice, and the aim of the present article is to consider the nature of this difficulty, and how it can be met. There are doubtless many of the older school, who received their training in the days before clinical pathology was thought of, who get along without it, trusting, as they were taught to do, in their own clinical acumen and common sense. But the man of modern training, who has realized during his hospital career how much help pathological methods can afford in suitable cases, feels the want of them acutely in many a doubtful or difficult case. The data derived from them have, in fact, become indispensable to the modern general practitioner, if he is to do his best by his patients.

There are some few men with a natural inclination for laboratory work who become, up to a point, their own clinical pathologists. Anyone with the necessary apparatus can stain sputa for the tubercle bacillus, or do blood-counts in his own consulting room. Such a practice is rare, partly because a man who is not regularly performing such tests comes to distrust his own powers, but chiefly because the pressure of a busy practice allows little time for investigations of the kind. The practitioner must therefore fall back upon the professional pathologist.

Should his practice be in a large town and should the patient be in a position to afford the necessary fee, no difficulty arises. A pathologist can be called in as readily as any other consultant, and the position is

analogous to that at a large hospital, where it is common for the pathologist to discuss a case with the clinician at the bedside. Emphasis must be laid, as every clinician will be ready to admit, on the value of this consultative element, in which the clinician can put his difficulties before the pathologist at first-hand, while the pathologist can see the case and ask any questions he chooses. Both parties, not to mention the patient, gain by such a procedure.

Nevertheless, in the majority of general practices such ideal conditions cannot be realized. Clinical pathology has to be carried out through the post, often by the aid of one or another of the clinical research institutions which have grown up in response to this particular need. A procedure of this nature requires careful consideration since it is that adopted by the majority of general practitioners.

There can be no doubt that many pathological examinations, and these the most frequently required, such as the staining of sputa, the examination of throat swabs for the diphtheria bacillus, and the Wassermann reaction, can be carried out quite well through the post provided that the practitioner is capable of furnishing suitable material.

To this matter reference will be made later. There are, however, other investigations, such as the more elaborate blood examinations, in which postal transmission is unsatisfactory and really reliable results difficult to attain. Here, if the pathologist cannot be brought to the patient, the patient must be taken to the pathologist. It is necessary for the practitioner to understand the limitations of "pathology by post."

The practice is not without its dangers in other respects, and of these the greatest is that it tends to lose what has been mentioned above as its "consultative" character—the ideal which the practitioner should always have in mind. There is, to put it bluntly, the

danger that it may degenerate into a "penny-in-the-slot" affair, in which the practitioner pays a small fee, and expects his diagnosis by return of post. For such a degradation of clinical pathology, should it occur, both parties must take some of the blame.

It is a common practice for the pathologist to relegate the technical part of the examinations he is asked to make to a trained laboratory attendant. This is reasonable enough, for experience renders such assistants very competent at laboratory technique, but it is to be feared that in some instances the share of the pathologist in the examination consists in little more than signing the report and receiving the fee. In such circumstances the transaction has become a purely commercial affair: the report may be a correct one, and may serve its purpose in many cases, but it has lost the element of personal consultation.

The practitioner, on his side, may justly argue that diagnosis is his province alone: he needs to know a certain fact and he pays for it. Why should he furnish full details of the case and explain his difficulties to someone who, for all he knows, may be an unqualified laboratory assistant? He often fails to realize that, to a conscientious pathologist, lack of full details may be a serious handicap in the interpretation of the findings. Thus he may not get from the examination all the help it might have been capable of affording. It should be obvious that the more he can succeed in interesting the pathologist in his case the more value is he likely to get out of him.

Certain conditions may be laid down which underlie the value of modern laboratory methods to the general practitioner who cannot himself carry them out. They may apply little to the simpler examinations which are often required, but they increase in importance with the elaborateness of the examination.

The first is that the practitioner should have been

so trained as to appreciate the help that clinical pathology can give. Under the conditions now existing at large hospitals and at most small ones, the student can hardly fail to gain a correct impression on the matter, and this without necessarily acquiring more than a general acquaintance with laboratory technique. He should have been taught how to collect and transmit through the post the material required for pathological examination.

He should know how to obtain a proper sample of sputum, free from buccal secretions; he should be able to take a faucial or pharyngeal swabbing, to take a syringeful of blood from a vein, and to do a lumbar puncture; he should know in what fixing solution a portion of tumour should be placed on removal from the body.

Every clinical pathologist knows only too well how often material arrives by post in so lamentable a condition as to be almost useless, simply because the general practitioner has been ignorant or careless as to such essential matters.

The second condition is that he should know, and trust, a pathologist (or an institution) whom he can take into his confidence. He should set forth a brief statement of the case and of the problem in which he requires help, with details of the nature of the material sent, and how and when it was obtained.

In this way he may be assured of obtaining all the help which the pathologist can give at a distance, and he may furthermore often get a hint as to any other form of examination which may perhaps throw light on a difficult case. It will be the nearest approach to a true consultation which can be obtained through the post. He will not, it is true, be as well off as the hospital clinician with a laboratory on the spot, for there will remain those examinations which cannot be done through the post, but he will be able, in the great

majority of the cases in which he wants pathological assistance, to get his requirements fulfilled. The value to him of what he thus obtains must depend on his own training and intelligence.

One thing remains to be said in conclusion. So valuable have modern laboratory methods proved, that the clinician, and perhaps especially the general practitioner, may be tempted to place too much reliance upon the pathologist. Clinical pathology by post is one thing, diagnosis and treatment by post are quite another. It cannot too strongly be insisted that the results of laboratory methods, often carried out without actual contact with the patient, must be kept in due perspective as factors only, though often very essential ones, in the full review of the facts concerning any particular case. They can never replace, for example, the thorough physical examination of the patient of which the principles have been handed down to us by precept and example as the result of long clinical experience. Had space permitted, it would have been interesting to quote illustrations of the errors which have arisen in practice from neglect of this elementary fact. It has, however, been necessary in this article to deal with general principles and not with details. The observations which have been made are perhaps evident truisms: none the less they may serve some useful purpose, if only from the fact that they are so often neglected or forgotten.

Value of Examination of the Eye in Diagnosis.

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WHEN the Controlling Editor invited me to contribute an article to this Special Number of THE PRACTITIONER, he stipulated that "only the general principles which should guide the man in practice are to be dealt with." It will be understood, then, that this is an article to try to assist the man in practice during his general examination of the patient, to obtain special information from the eye, and not for the man who, by a special examination of the eye, obtains general information about the patient.

The diagnostic value of examination of the eye lies in its potentiality for confirming a suspicion, or for arousing a suspicion, and in one class of case—hypophyseal tumour—in being the sole arbiter for conviction or acquittal of a suspect.

I will presuppose the possession of two instruments only, the binocular loupe and the electric ophthalmoscope.

The most convenient subdivision will be into the following: (1) External examination and subjective testing, with deductions; (2) internal examination, with deductions.

1. EXTERNAL EXAMINATION.

Observation is the most important external examination.

Lids.

Œdema will suggest renal disease, if not due to local conditions.

Ptosis, when not congenital, trachomatous, or trau-

matic, suggests third nerve paralysis of syphilitic or cerebral origin; it is also a distinctive feature in myasthenia gravis.

A slight droop is apparent in sympathetic nerve palsy. The reverse process is seen in Graves' disease, where the staring appearance is characteristic, due to the protrusion of the globes, and retraction of the lids, owing to stimulation of the sympathetic system. On making the patient look first up and then slowly down, fixing a pencil held horizontally before the face, it will be noticed that the upper lid lags behind during the downward movement of the globe, allowing an interval of sclera to be seen between the lid margin and the cornea (von Grafe's sign). Blinking movements are less frequent, and imperfectly performed.

Cornea.

Diffuse nebulæ, if associated with remains of blood-vessels terminating at the scleral margin, detected by the binocular loupe suggest interstitial keratitis of syphilitic origin.

Phlyctenular ulcers, or small discrete nodules at the corneoscleral margin in children, suggest a toxi-tubercular condition, especially if of frequent recurrence, and resistant to treatment.

The Sclerotic.

Gouty, rheumatic, or infective conditions may manifest themselves in localized nodules or diffuse inflammation of the sclerotic and episcleral tissues.

Iris and Pupil.

Very valuable information as to the existence of disease of the central nervous system may be obtained from accurate investigation of the iris and pupil; the converse is equally true, that very erroneous deductions may be drawn from a casual examination. I would suggest that no verdict be pronounced upon a

pupil till it has been examined with the binocular loupe—a sluggish reaction, due to senile fibrosis of the iris fibres, will not then be condemned as an inactive pupil, or an inactive pupil, due to post-synechiæ from old iritis of septic origin, be mistaken for one of central origin.

Inequality of the Pupils.

Unequal pupils, often combined with myosis, are found in tabes and G.P.I., but in my experience a very frequent cause is injury, therefore definite questioning on this point must not be omitted, and a careful examination of the pupil margins should be made with the loupe, to note irregularities or tears of the sphincter muscle.

Again, the condition is not infrequently due to an interference with the sympathetic nerve supply to the dilator fibres of the pupil on one side, as, for instance, in cases of pressure on the sympathetic from enlarged cervical glands.

The condition may readily escape notice, but the aspect of the individual that draws attention to the condition is a slight droopiness of one lid, and, on further examination, the pupil is found to be slightly contracted. Compare this with ptosis, and a dilated pupil due to third nerve paralysis.

Periodically contracted pupils in an individual are very suggestive of the morphine habit.

I have so often found, in my post-graduate classes, a certain slovenliness in testing the pupil reactions, and an uncertain interpretation of their meaning, that I trust the following remarks will not be considered too elementary.

The objects in view are to test: (1) the efficiency of the light reflex consisting of the afferent path from the retina via the optic nerves and tracts to the third nerve nuclei, and the efferent path, from the third nerve nuclei via the third nerve, ciliary ganglion, and

short ciliary nerves to the iris; (2) the presence of the reaction to convergence or accommodation.

To ascertain these points: Put on the binocular loupe, use good daylight or artificial light—an electric torch is very serviceable—direct the patient's gaze to some distant object, to avoid convergence. Place both hands over both the patient's eyes, then uncover one eye, and note if the pupil contracts; repeat the same process with the other. Direct reaction to light is present or absent in each eye. Again cover both eyes, stand at one side of the patient, so that the pupil can be observed behind the hand on that eye, uncover the other eye, and note if the pupil on the protected side contracts when its fellow is exposed to light—consensual reaction to light.

To test the convergence reaction, make the patient fix some distant object; hold a pencil six inches from his face, and make him suddenly alter his fixation from the distant object to the pencil; note the presence or absence of contraction of the pupils.

The absence of the direct reaction to light of one pupil may arouse suspicion, which is removed by the presence of the consensual reaction, and proves that the cause of the condition is a lesion between the retina and the chiasma, and not one of central nervous origin.

The Argyll-Robertson pupil is that condition in which the pupils react to convergence, but not to light, and is found in tabes, G.P.I., or syphilis of the central nervous system.

The Fields of Vision.

These can be taken effectively, if roughly, by standing straight in front of the patient at a distance of three feet; the patient has each eye in turn obscured; the observer has the opposite eye closed to that of the patient, i.e. if the patient's right eye is being examined (and, therefore, his left eye closed), the observer

has his right eye closed. The field of vision of the patient's right eye will correspond with the field of vision of the observer's left eye. The patient must fix without wavering the centre of the observer's pupil. A 10 mm. square of white paper on the end of a pen will readily elicit any gross defect, such as homonymous hemianopia, or bi-temporal loss of fields, which are the two conditions of general diagnostic importance to be sought for. Hypophyseal tumour, with its characteristic loss of perception of colour first, and form later, in both temporal fields—in the earlier stages the upper temporal quadrants alone may be affected—can be diagnosed by this test, and confirmed by this test alone. A central scotoma for small specks of colour, with full peripheral field of vision, suggests tobacco, alcohol, or diabetic poisoning; disseminated sclerosis, retro-bulbar neuritis, as in sinusitis, and occasionally tabes, when the condition is not due to macula disease.

Ocular Muscles.

Paralysis of ocular muscles and associated ocular movements is a subject that can only be dealt with briefly.

Diplopia is the cardinal symptom, and the lesion may be situated in any part of the nervous tract from the cortex cerebri to the muscles. The general principle is that conjugate ocular movements are cortical in origin, while nuclear and peripheral lesions affect the motility of a muscle, or muscles, of one eye, according to the nerve supply involved.

The ætiology of ocular paralysis is the ætiology of intracranial lesions, syphilis and parasyphilis, vascular lesions, tumours, disseminated sclerosis, plus certain peripheral causes, such as diphtheria, "rheumatic" or infective conditions, associated with migraine—recurrent paralysis—it also follows injections into the spinal theca to produce anæsthesia. Injury is especially

liable to involve the sixth nerve, owing to its lengthy and exposed course; it not uncommonly occurs following fracture of the base of the skull.

Nystagmus.

Nystagmus may be congenital or acquired. The history of the case will help to decide the relevancy of its diagnostic importance. It is a prominent symptom of disseminated sclerosis, cerebellar tumour, and labyrinthine disease, and affects miners owing to the imperfect illumination and cramped posture involved in their work, when it can be looked upon as a form of occupation neurosis. It is more commonly seen in its congenital form due to local ocular defects—it is almost constantly present in albinism, partial or complete.

Errors of Refraction and Muscle Balance.

These are undoubtedly responsible for headache and various algias in a certain proportion of patients suffering from these complaints. The measure of their responsibility must be sensibly weighed in each case, but of recent years there has been a tendency to exaggerate their importance as ætiological factors, and to condemn to a life sentence of spectacles individuals who are suffering from some temporary form of physiological insolvency.

2. INTERNAL EXAMINATION.

Ophthalmoscopic examination of the fundus for the purposes of this paper should be concentrated on the condition of: (1) the optic nerve; (2) the blood-vessels; (3) the retina and choroid.

The Optic Nerve.

There are two varieties of inflammation of the head of the nerve, characterized by swelling and obscuration of the disc margins, which differ widely in

ætiology, and, consequently, in diagnostic importance. They are differentiated under the headings of papillœdema and optic neuritis.

Papillœdema.—The term papillœdema is applied to that condition of the optic nerve where a marked striation of the margins of the disc is found, with definite swelling and elevation of the nerve head above the plane of the retina.

The swelling and striation are due to œdema caused by increased intracranial pressure transmitted to the subdural space of the sheaths of the optic nerves.

The veins are greatly congested, and there may be hæmorrhages and exudates in the swelling, which is limited to the nerve head, although œdema at the macula may be present in the shape of radiations of bright white lines. Frequently there is little interference with acuity of vision.

The ætiology is the ætiology of increased intracranial pressure; intracranial tumour of every description, hydrocephalus, meningitis (especially the tuberculous form), abscess, gumma, and neoplasm. Papillœdema is always specially well marked in subtentorial tumours.

The condition is nearly always bilateral, and the swelling may amount to six or eight dioptres, the nerve head protruding into the vitreous like a mushroom, though the degree of the swelling may vary in the two eyes.

Optic Neuritis.—Optic neuritis is the term applied to a similar appearance of the optic nerve of a less severe character—the swelling never approaches the amount seen in papillœdema; but the retina is frequently involved, exhibiting cloudiness, hæmorrhages, and exudates (neuro-retinitis). In contradistinction to papillœdema the vision is greatly lowered, and the condition is frequently unilateral (when due to focal infection). The ætiology is toxæmic; syphilis, albu-

minuria, diabetes, influenza, and septic conditions in the mouth, nose, and throat, sinusitis, apical abscess of the teeth, etc., are the main causes. Retro-bulbar neuritis with central scotoma is of this description, but ophthalmoscopic changes are limited to the nerve head.

Optic Atrophy.—This must also be subdivided for purposes of contributory diagnosis into primary and secondary.

In primary optic atrophy the disc margins are clearly defined, the disc is of a grey-white colour, and frequently the blood-vessels are unaltered in size and appearance. Tabes and G.P.I. account for the majority of these cases, but the condition occurs in disseminated sclerosis, and as the result of pressure effects or injury. In hypophyseal tumour, optic atrophy is the rule, papillœdema a very rare exception.

In optic atrophy, secondary to previous optic neuritis, owing to inflammatory exudation and subsequent organization of the exudate into fibrous tissue, the disc margins are obscured, the physiological cup is filled in, and the vessels may have sheaths of fibrous tissue along them. In a typical case the conditions are unmistakable, but frequently it is impossible to be dogmatic as to the pre-existence of a neuritis or not.

The Blood-vessels.

Invaluable evidence of general systemic disease may be furnished by the retinal blood-vessels.

Arterio-sclerosis and high blood-pressure can be diagnosed by sight; the thickened arteries can be seen to compress the veins where they cross each other, leading ultimately to obliteration of the lumen of the thin walled vein, and hæmorrhagic leaking along its course. Visible alterations in the calibre of the artery are diagnostic of arterio-sclerosis.

Embolism or thrombosis of retinal arteries or veins

may throw a valuable light on obscure cerebral conditions due to similar cardiac or vascular lesions.

The Retina.

Syphilis, all forms of nephritis, and glycosuria are the principal causative agents of retinal inflammation. A diffuse cloudiness of the retina with optic neuritis and fine vitreous opacities will suggest syphilis. In albuminuric retinitis, variations in details will be found, but the general picture includes papillitis, sometimes of great intensity, resembling that found in cerebral tumour, congestion of the veins, flame-shaped hæmorrhages, and white exudates in the peripapillary area, and a brilliant star formation of radiating white lines at the macula.

In diabetes the changes are somewhat similar, except that papillitis is rare, the hæmorrhages are more frequently seen as discreet round spots, and glistening brilliant white patches and dots are of common occurrence.

The Choroid.

Grossly disseminated patches of choroido-retinitis fringed with pigment are a frequent indication of syphilitic infection, whereas larger solitary areas of choroidal atrophy are suggestive of a tubercular origin.

CONCLUSION.

In the foregoing pages I have endeavoured, within the terms of reference, to draw the attention of the traveller to a series of ocular signposts. The ultimate destination may not be inscribed upon any one of them, but by reading them systematically, and not ignoring them, will the journey be wisely and profitably hastened.

Cystoscopy in Diagnosis.[1]

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THE cystoscope is the key to diagnosis in diseases of the urinary tract. Without the cystoscope diagnosis in 50 per cent. of cases of urinary surgery is little more than guess-work. With the cystoscope, and especially when ureteral catheterization and X-ray examination are combined with it, diagnosis in diseases of the urinary organs is more accurate and more complete than in any other system in the body.

A few years ago it was no uncommon experience to examine a case of hæmaturia and find that the patient had the scar of a negative renal exploration. Cystoscopy showed a papilloma in the bladder. Such cases do not now exist, for it would be considered unjustifiable to operate on a case of hæmaturia without first cystoscoping the patient.

In my Hunterian lectures for 1907 I collected from the current literature ninety-five cases of operation upon one kidney when anuria and uræmia followed the operation. In these cases no suspicion had been entertained before embarking on operation that a second kidney was not present or, if present, was not sufficiently healthy to maintain the renal function.

These were largely cases of tuberculous or calculous disease, and the second kidney was either absent or the seat of advanced disease when examined after death.

Such operation tragedies are now abolished from urinary surgery by careful preoperative examination with the cystoscope, and the ureteral catheter.

At the time when the question of cystoscoping a patient arises and he presents only a urinary

symptom or a group of urinary symptoms, it is a case of hæmaturia or of pyrexia or of frequent or difficult micturition, or a combination of these symptoms. There is as yet no certain diagnosis.

Or, on the other hand, the case is known to be one of infection of the urinary tract with the *Bacillus coli* or with the tubercle bacillus, and it is proposed to search for the chief focus of infection. Or the diagnosis of disease of one kidney has been made and before operating upon it the presence or absence of disease and the condition of the renal function of the second kidney is to be examined.

I shall discuss the following points:—

1. The investigation of urinary symptoms by the cystoscope.

2. The estimation of the renal function by the cystoscope.

1. THE INVESTIGATION OF URINARY SYMPTOMS BY THE CYSTOSCOPE.

(a) *Hæmaturia.*—Hæmaturia is usually intermittent. It is a symptom, not a disease, and the clearing of the urine does not mean the cure of a disease. Unfortunately the patient, and not infrequently the practitioner also, finds difficulty in realizing this point, and it is only after repeated attacks of hæmaturia and a considerable period of time has elapsed that the patient is submitted to complete examination by the cystoscope.

In a case where hæmaturia is the principal symptom two problems arise. First, the localization of the bleeding to one part of the urinary tract; and second, the investigation of the cause of the bleeding. These two points may be settled simultaneously, or the bleeding may be localized (say, to one kidney), but the actual cause remains obscure.

The presence of other symptoms may suffice to

localize the hæmaturia and permit a diagnosis as to its cause. Pain is one of the most valuable localizing symptoms. Hæmaturia with renal colic points to one kidney as the source of the bleeding and suggests, although it does not definitely prove, the presence of a stone as the cause. But hæmaturia with pain amounting to renal colic may be due to infection of the renal pelvis and descending enteritis, and pain of slighter character in one kidney, together with hæmaturia, may not be due to disease of the kidney at all, but to a papilloma of the bladder situated near one ureteric orifice.

Frequent micturition, difficult micturition, and enlargement of the kidney are localizing symptoms, but if used without further confirmation may prove fallacious.

It is advisable therefore to use all the accompanying symptoms of hæmaturia as a means of localizing the hæmorrhage and diagnosing the cause but to remember that these symptoms may prove fallacious, and it is necessary in all such cases to cystoscope the patient. There is a class of case of hæmaturia where no other symptoms are present, the so-called "symptomless hæmaturia." Here there is nothing to help either in localization or in diagnosis. Such silent bleeding may come from either kidney or ureter, the bladder or the prostate. The two methods of investigation that have been used in such a case are exploratory operation and cystoscopy. No one would ever think of emptying the bladder or a kidney by a random operation when cystoscopy is available, but this attitude is of comparatively recent date. Cystoscopy must then be carried out while the bleeding is in progress. The practitioner not uncommonly waits until the bleeding has ceased, with the idea that the blood may obscure the cystoscopic view. It is only in the very rarest case that there is any difficulty in obtaining a clear view by washing the bladder, whereas if a renal hæmorrhage has

ceased at the time of the cystoscopy, there is no clue as to which kidney has been bleeding. There are cases of symptomless hæmaturia when the bleeding is evanescent and has ceased at the time of the cystoscopy. These are serious cases. In some the bleeding is of the type we know as "essential hæmaturia," for want of a better name. There is bleeding from a kidney which shows even on removal no recognizable disease. But some of these are cases of early growth in the kidney. There is a very great danger in these cases that the rapidly disappearing hæmaturia may be neglected, and I have seen a number of cases in which this has happened and the patient has eventually come with a growth of the kidney so advanced as to be inoperable.

In one case the patient, tired of repeated attempts to locate the hæmaturia, and always somewhat sceptical as to whether his doctor or surgeon knew as much as he did, resorted to treatment by an osteopath who, nothing loth, beat his back with a hammer with the object of replacing a supposed displaced vertebra. After many months of this treatment the hæmorrhage became serious and continuous, and he returned to have a further surgical examination. By this time the right kidney was much enlarged, and the patient obviously emaciated. I removed the kidney, but there were secondary deposits in the abdominal glands, and the patient died six months later.

In renal hæmaturia it is necessary to find out as soon as possible which kidney is bleeding. For this purpose the surgeon, the practitioner, and the patient must arrange that when blood reappears in the urine cystoscopy must be carried out at once. Even with careful arrangements for this purpose the bleeding may cease before the cystoscopy, and it may require many attempts before blood is seen to issue from one ureter.

In a case of intermittent renal hæmaturia, where the bleeding has ceased, and the urine appears clear to the

naked eye, there may still be a few red-blood corpuscles in the centrifugalized deposit of the urine. If a ureteral catheter is very carefully passed, and a specimen of urine obtained from each kidney, the blood-cells may be found in the specimen obtained from one kidney, and not in that from the other. Unfortunately this method is apt to be fallacious, for the passage of the catheter, even when gently and skilfully carried out, may cause very slight bleeding and vitiate the result.

Something may be gathered from the presence of fresh blood corpuscles indicating recent bleeding as from the effect of the catheter or decolorized blood corpuscles, or "ghosts," pointing to a bleeding which occurred before the catheter was introduced. In one case there were peculiar fatty cells in the specimen from one kidney and none in that from the other.

Relying upon this I operated and found a large growth which could not be felt through a very thick abdominal wall. If, on passing the ureteral catheter, there is an immediate flow of blood in quantity, and especially if the blood is dark in colour, the side of the hæmaturia is definitely demonstrated.

Pyelography consists in passing a fine catheter up the ureter to the renal pelvis, and introducing a fluid (sodium bromide, 20 per cent.) opaque to the X-rays. By this means a silhouette of the renal pelvis and calices is obtained. The distortion of the shadow caused by a renal growth projecting into the renal pelvis can be recognized. This method is of great value in intermittent hæmaturia, when the side of the hæmorrhage is known or suspected, and I have operated on a growth of the renal pelvis where the evidence consisted in a previous attack of renal hæmaturia, a slightly reduced urea content of the urine on one side, and a peculiarly distorted renal pelvis as shown in a pyelogram.

(b) *Pyuria.*—The localization of pyuria is equally

important with that of hæmaturia, for successful treatment of the infection causing it depends upon the diagnosis. Usually there is definite pain that will assist. There are, however, many obscure cases where the source of the pyuria can only be discovered by the use of the cystoscope and the ureteric catheter. An attempt will first be made by abdominal palpation and examination of the prostate and seminal vesicles to ascertain whether the chief focus of inflammation is in the upper (kidneys, renal pelvis, and ureters) or the lower urinary tract (bladder, urethra, prostate, vesicles), and an X-ray examination may be necessary.

Cystoscopy will show whether the source of the pyuria is in the bladder, and due to such conditions as stone, diverticulous growth, enlarged prostate with residual urine, or a sacculated bladder.

On examining the ureteric orifice there may be some change such as inflammation surrounding the orifice, swelling of the lips, a rigid open orifice, or a displaced tunnelled orifice which indicates that the source of the pyuria is the kidney of this side. The efflux may be purulent. A slightly cloudy efflux is very difficult to recognize as the bladder is usually inflamed and forms a dull, light-absorbing background against which to view the jet of urine. When, however, the efflux under examination momentarily clouds the field, obscuring everything, and clearing again, the presence of pus in the urine of that kidney is definitely proved. When the urine is thick with pus, and when in the advanced stage of pyonephrosis, the pus is squeezed out of the ureter at intervals like lanoline out of a collapsible tube, the source of this pyuria is easily recognized.

In many cases the ureteric catheter is necessary in order to localize the pyuria, and even when pus is definitely seen in the urine of the kidney it may be necessary to obtain a specimen of the urine of the opposite kidney to ascertain if infection is present in

that kidney also, and possibly also to investigate the function of the kidney.

(c) *Frequent Micturition.*—Frequency of micturition is so closely allied to pyuria that what has been said in regard to pyuria applies also here. There are, however, cases in which the pyuria is minimal, or completely absent, and frequent micturition is pronounced. These are often difficult cases for diagnosis and treatment. In women there may be very distressing frequency of micturition with little, if any, change in the urine. An intermittent or a constant bacilluria may be present without cystitis or pyuria, but with intense irritation. On cystoscopy the bladder will be found healthy, or shows only a little reddening at the base.

A condition known as trigonitis is very common in women. It is usually due to a mild, ascending infection, and as the name indicates, affects the trigone. The urine contains a few bacteria (*Bacillus coli* or staphylococcus), and the cystoscope reveals a reddened trigone, which is frequently covered with a fine whitish film. In a more severe form I have seen the trigone intensely inflamed and covered with large shreds of desquamated epithelium.

In a condition known as cystic cystitis there are numerous small sago-grainlike bodies on the mucous membrane, and grouped especially at the base. There may be no inflammatory change, and the urine may be sterile or mildly infected. The condition is usually accompanied by intense neuralgic pain and frequent micturition.

In other cases of persistent frequency of micturition there is universal dilatation of the vessels of the mucous membrane without inflammation.

(d) *Urinary Obstruction.*—Obstruction in the urinary tract may be in the urethra or the ureter. Urethral obstruction is due to stricture or enlarged prostate.

The diagnosis of stricture is made by other methods, and need not be discussed. Where there is pronounced enlargement of the prostate, cystoscopy is better avoided, owing to difficulty in introducing the instrument, the likelihood of bleeding, and the reflex effect on kidneys already damaged. Further, it is rare that any useful object is gained by the examination in such a case. When, however, the change in the prostate is slight, and there is a reasonable doubt whether the symptoms are due to the prostate or to some other undiscovered cause, cystoscopy is invaluable.

In moderate enlargement of the prostate, changes are seen at the internal meatus. There may be a projecting rim all round the meatus, or the posterior lip may show a projecting wound or a definite wounded lobe. Or two lobes may project, so that they form a Λ shape when the cystoscope is partly withdrawn into the urethra with the window looking forward.

The ureteric orifices may be seen with difficulty over the top of the prostate, and this is a measure of the intravesical projection.

In the absence of definite intravesical projection other conditions, such as cyst of the prostate or a diverticulum of the bladder, may be discovered.

Obstruction of the ureter may be due to stones or stricture, or to some kink produced by adhesions, or to the presence of an aberrant renal vessel.

The absence of an efflux and of any movement at the ureteric orifice does not prove an obstructed ureter, for the ureter may remain quite still for some minutes under observation. Gentle massage of the kidney may stimulate the renal pelvis and ureter to contract and produce an efflux at the ureteric orifice.

Chromocystoscopy is a useful method of examining the ureteric efflux. By this method, which will be described later, a lazy trickle of blue urine may be seen

at the orifice of the obstructed ureter, and compared with the full vigorous jet of the sound ureter. When the obstruction is complete the efflux will be absent.

The passage of a ureteral catheter or bougie is a further aid in the diagnosis.

The catheter is arrested at the point of impaction of the calculus or the site of the stricture. A catheter may, however, be arrested by a fold of mucous membrane, or by a spasm of the ureter, without any permanent obstruction being present. This occurs most frequently in the lower one or two inches of the ureter. Occasionally a catheter of small size will pass when a large one has failed.

The catheter may pass by an impacted stone after slight hesitation, and on withdrawing the instrument a peculiar dragging sensation is felt.

When the obstruction is at the outlet of the renal pelvis the catheter will usually pass into the pelvis although the urine is completely retained.

Pyelography gives invaluable assistance in the minor degrees of hydronephrosis.

2. ESTIMATION OF THE RENAL FUNCTION BY THE CYSTOSCOPE.

I have already insisted on the necessity of examining the renal function of one kidney before performing an operation on its neighbour. For the examination of the total renal function performed by the combined kidneys cystoscopy is not necessary.

For the separate examination of the function of one kidney two methods are available:

(a) Chromocystoscopy.

(b) Catheterization of the ureter.

(a) *Chromocystoscopy.*—Chromocystoscopy consists in injecting 20 c.cm. of a saturated solution (0·4 per cent.) of indigo-carmine into a muscle and examining the bladder with a cystoscope. After 12 to 20 minutes the

urine becomes tinged with blue, and after three-quarters of an hour it is a deep blue colour. Examination of the efflux at each ureter will show a jet of dark blue urine.

Delay in the appearance of the blue, a fainter staining of the urine, or the complete absence of blue colour on one side, is taken to show a diminution or absence of the functional power of the kidney. This method is extremely useful when a rapid proof of the presence of a functional kidney is required, but it is not sufficiently reliable for accurate work on the renal function.

An important use of chromocystoscopy is when a fistula of the ureter has followed hysterectomy and opens in the scar in the vault of the vagina. The surgeon is uncertain which ureter is fistulous. With chromocystoscopy the healthy ureter will be seen to discharge a deeply stained efflux while the efflux is absent on the injured side. Chromocystoscopy may also be used as an aid to finding the ureteric orifice when the bladder is diseased.

(b) *Catheterization of the Ureter.*—A sample of urine may be obtained from each kidney by catheter and the percentage of urea examined. This is sometimes useful in demonstrating the diseased side in a doubtful case.

When one kidney is known to be diseased and an operation on it is to be performed, the function of the second kidney should be accurately examined. This is best carried out by combining the urea concentration test with catheterization of the ureter. A draught of urea (15 grams) is given by the mouth after abstinence from fluids for 8 or 10 hours.

The ureter of the supposed healthy kidney is catheterized during the second hour after the administration of the draught, and a sample of urine from the kidney obtained, and the percentage of urea in it examined. This will show the full capacity of the kidney to excrete urea.

Blood Pressure in Diagnosis.

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A DEGREE of blood-pressure that shall ensure a due supply of blood to the vital centres is essential to the continuance of life, and this being so, the "call" of these centres upon the circulating mechanism to activities and adaptations under varied general conditions and local impediments is imperative. In diagnosis we have to endeavour to interpret the meaning of any diversion of blood-pressure from the normal, regarding the sign in itself as an index, rather than as a primary factor, in the symptomatology of the case before us.

The mean pressure of blood within the vessels is primarily due to the rhythmic contraction of the ventricles of the heart and the elastic recoil of the arteries against the closed aortic and pulmonary valves. The current is distributed and expended in its passage onwards to the veins, but its escape through the arterioles is regulated by their contractility which varies in degree from that of mere *tonus* to almost complete closure, and each organ is, so to speak, rationed of blood supply by vaso-motor control. By the time the blood arrives at the venous capillaries its onward impulse (the *vis a tergo*) is almost exhausted. A certain reaction within the capillaries between the blood and tissue elements, which has for its object the absorption of nutritional, and the excretion of more or less effete materials, probably acts on balance in advancing the current onwards through the venules; and

as it gathers volume in the wider veins it is further urged forwards by the pressure derived from adjacent muscular action directed by the venous valves until finally, at the auricles, it is propelled by their contraction into the ventricles. The lymph stream in its ebb and flow has its tidal influence upon the blood volume and pressure. A constant and not unimportant aid to the returning current is the aspiration towards the mediastinum caused by the elastic traction of the lungs, reinforced by the expansion of the thorax during inspiration. This aspiratory force is, of course, in action against arterial output, as well as in favour of venous return, but is only effectively operative upon the sluggish current of return in the larger veins.

The mean result of these several forces and retardations is the condition of general pressure under which the circulation of the blood is maintained and is spoken of as the *medium*, or less accurately as the *diastolic* blood-pressure. The impetus derived from ventricular contraction is that pulsatile addition to the mean which constitutes the *maximum* blood-pressure. This addition is called the *pulse pressure.*

The older physicians were quite aware of heightened conditions of blood-pressure which they described as "plethora with bounding pulse," "incompressible pulse," etc. The term incompressible is still used to denote that condition of pulse indicative of high arterial pressure in which, when the radial artery is absolutely closed by the compression of the finger, the vessel beyond will still be found to be full and pulsating. Carefully testing with the second finger, however, it will be noted that the impulse comes from the peripheral side, and it is at once stopped by compressing the ulnar artery.

An appreciation of the pulse includes an estimation of its tension, and only in some five or ten per cent. of our patients is an instrumental examination of blood-

pressure necessary. In life assurance, however, the blood-pressure, both mean and maximum, should be recorded in all persons above the age of forty. Instrumental estimation of the intra-arterial pressure was first used clinically by Riva Rocci and Dr. Leonard Hill in 1896. But it was already indirectly employed in the use of the sphygmograph by Marie in 1876. In order to get a correct tracing of the pulse it is necessary to press down the lever of the sphygmograph upon the radial artery with a certain measurable force at which the most characteristic tracing is recorded; under too light a pressure the record is vacillating and unsatisfactory, and with too heavy a pressure it becomes blurred or obliterated. It requires some experience to determine the right degree of pressure equivalent to the mean diastolic blood-pressure which varies in different individuals within a certain range and at different times in the same person.

I need not here describe the several instruments which have been devised for the estimation of blood-pressure of which the mercurial pressure gauge designed by Riva Rocci and the aneroid instrument of Dr. Leonard Hill are most employed. The principle is that by a certain pressure produced upon the brachial artery by inflating an air-cushion circlet, about four inches broad, round the upper arm, which is in communication with the mercury of a manometer or the needle of an anemometer, the pulsation of the vessel is recorded, and the degree of pressure used is registered in milligrammes by the index of the instrument. I am myself accustomed to using the aneroid sphygmomanometer of Leonard Hill, modified by Dr. Rogers. The pressure recorded at which the pulsation is most complete and characteristic is the *mean intra-arterial* pressure, and that at which the pulsation becomes obliterated and the radial pulse extinguished is the extreme or maximum. The record of mean pressure

is less exact than that of maximum pressure. It lies between the point at which the pulsation of the needle first appears and that at which it is most characteristic, the latter being the right point for estimation. As with the use of the sphygmograph some experience is needed in attaining accuracy.

The reading of the index may thus be noted at three periods: (1) at the point of pressure at which fluctuation first appears—*the minimum pressure*; (2) that at which the tracing is most free and a characteristic record of the pulse—*the medium pressure*; and (3) that at which the fluctuation ceases and the pulse is obliterated—*the maximum pressure.* The medium is often spoken of as the diastolic pressure,[1] and that addition to it to make up the maximum which is directly due to the ventricular impulse is called *the pulse pressure.* In clinical work the records 2 and 3 of the sphygmomanometer are of real importance, the variations of the mean or diastolic pressure signifying mainly the degrees of resistance to the circulation, whilst the additional pulse pressure (to make up the maximum) indicates especially the cardiac effort and power. The sometimes so-called minimum pressure at which fluctuation first appears marks the point at which the resistance of tissues is overcome and the instrument comes within touch of the artery.

The first release on decompression (systolic pressure) and the completely restored flow through the artery (diastolic pressure) can be recognized by auscultation over the brachial artery below the point of compression. This "auditory method" of estimation, designed by Korotkoff in 1906, is generally regarded as more accurate. I confess to a preference for the simpler method.[2]

It may here be noted that sphygmometric observations, like all instrumental records, are only for occasional use, and by no means supplant the information gained

from the pulse through the skilled finger; they are of value as permanent records and as testing, and sometimes correcting, pulse observations. A pocket instrument has been designed to obtain similar pressure records directly from the radial artery, which is convenient, perhaps, for rapid work.

The normal blood-pressure varies with age, and there are diurnal variations—some increase after meals, during exercise, and some diminution with fasting. These normal fluctuations may amount to 10 or 15 milligrammes, but these allowed for on one side or the other, the pressure is fairly constant for the individual and according to age. (I am speaking clinically; for the purposes of physiological inquiry, of course, attention to minute details and conditions of variation would be necessary.)

For male persons under the age of thirty the average mean blood-pressure is 80 mg., the maximum 120 to 130. The minimum pressure is some 10 mg. below the mean. Between the ages of thirty and fifty the mean pressure rises somewhat towards the latter age to 85 or 90, and the maximum to 130 or 140. Between the ages of fifty and sixty-five the mean may be 85 to 95, maximum 140 to 160. With females the pressure ranges about 7 mg. less than in males. Oliver takes 45 mm. as the average pulse-pressure, which increases 1 mm. every two years from ages forty to sixty, and each year after sixty. Bearing these general points in mind we would regard a maximum pressure of 150 in a man below the age of fifty or of 160 beyond that age as requiring investigation. Under morbid conditions the maximum pressure may rise to over 200 mg., and the mean to over 100.

It is of importance in taking pressure records—as in estimating the pulse—to take into consideration such circumstances as food, exercise, or mental excitement or depression, which may render some allowance

necessary, and only by repeating observations at different times can a perfectly satisfactory record be ensured. In examining for life assurance, however, only one observation is, as a rule, possible, and a note of any disturbing conditions of a temporary character should be appended to the record.

A blood-pressure observation is only one item in the presentment of a case. This being remembered, we may ask what is its value. There is probably no such thing as an idiopathic "hyperpiesis," a term under which Faught endeavoured to differentiate a purely functional hypertension, although he admits it to be always a sign of the beginning of a pathogenic change. The nearest approach to such may, perhaps, be found in premenstrual and climacteric high pressures, and in those of emotional origin, including some cases of pseudo angina, all associated with temporary vaso-motor constriction of arterioles.

1. A normal record is evidence *pro tanto* that the heart and vessels are sound, and that there is no toxic or other condition of the blood to increase the resistance to its passage through the small vessels, nor any reflex or mental cause to excite the contraction of the arterioles.

2. A diastolic pressure relatively high to the maximum indicates that with increased resistance the margin of heart-power is diminished. On the other hand, a high maximum with a relatively low diastolic pressure, i.e. a high pulse pressure, if it be not accounted for by some emotional relaxation of arterioles with excitement of heart, points to some defective support to the circulation as from impairment of aortic valves permitting regurgitation, causing an extra demand upon the cardiac systole.

3. The conditions of the vessels must be examined as to whether there be hardness and thickening present, tortuosity of the temporals, or undue visibility of the

radial and brachial arteries, and want of elastic adaptation of the latter when the arm is flexed.

4. Any enlargement of heart, displacement of apex beat, *excited* or hypertrophic impulse, or evidence of any cardiac defect or insufficiency of valves will be looked for. Accentuation, and often reduplication, of the second sound may generally be observed with high blood-pressure.

5. Mental conditions have a very decided influence on blood-pressure. Lord Dawson,[3] investigating the blood-pressure of 650 school children between the ages of 10 and 17, observed a heightened pressure in a larger proportion of those entered for the higher examinations, which he regarded as due to continued intentness and anxiety, an existing state of mind intensified by straining. What may be described as mental harassment, overstrain of work, and especially anxiety of work, the repeated need for rapid and critical decisions such as obtain in the crowded and responsible lives of many professional and business men, are fruitful causes of arterial tension. Premature arterial changes are prevalent amongst such persons, but the first sign of danger is an excessive range of arterial pressure. It must not be forgotten, especially in the guidance of these cases of strenuous vocations, that they are not uncommonly accompanied by irregular meals, rapid eating, dietetic indiscretions, and often irregularity or excess in alcohol. Certain people are temperamentally disposed to take life at high pressure, and unquestionably premature arterial changes are observed in certain families. Nerve shocks, whether emotional or from such lesions as perforation of the pleura or peritoneum, inhibit the heart's action and cause lowering or collapse of pressure.

6. Varied sources of toxæmia will be considered—defective metabolism. Overweight is frequently asso-

ciated with heightened blood-pressure and requires very careful assessment in life assurance.

The state of the gums and fauces must be examined for pyorrhœal or other septic conditions, and the teeth looked to, as a source of reflex irritation.

7. In all cases of heightened blood-pressure it is important to examine carefully into the abdominal condition. Defective function of the colon is a frequent source of disturbance. The toxins absorbed from the lower bowel seem to be the offending agents.

8. A low range of specific gravity of the urine in the presence of a raised blood-pressure is a hazardous combination suggesting interstitial nephritis. A high range of specific gravity with lithiasis is of less grave significance, suggesting excess of diet, defective exercise, etc., which can be corrected. Gouty and glycosuric conditions of urine are commonly associated with increased pressure of blood, whilst in the genuine forms of diabetes I would say that the pressure is lowered, but I have no records to confirm this.

9. The cancerous cachexia and all cases of visceral cancer are attended with a lowered arterial pressure. External cancer in the earlier stages is not so attended. Tuberculosis in the acute phases of the disease causes a lowered pressure, but in chronic and quiescent periods of the disease the blood-pressure is fairly well sustained. It is in marked contrast with cancer in this respect.[4] All acute infections are associated with a depressed blood-pressure, probably from the immediate effect of the toxins upon the cardiac musculature. Influenza and diphtheria poisons are especially venomous to the heart. Disease of the suprarenal glands, which are probably the media through which the causes of altered arterial pressure become effective, is attended with depressed blood-pressure. There does not seem to be sufficient evidence in cases of extra blood-

pressure of suprarenalism analogous to thyroidism, but there is unquestionable evidence of the opposite condition in the collapse of arterial pressure which attends the impaired function of the adrenals in Addison's disease.

10. Alcoholic excess tends rather to lower pressure unless in moments of excitement or when accompanied by organic changes, especially in the kidneys. Excess of smoking tends to raise blood-pressure rather in a spasmodic way through irregular contractions of the arterioles, but later, it may be, from arterial changes. In other cases by depressing heart-power it has a lowering effect.

11. As might be supposed, cardiac diseases are attended with characteristic differences of intra-arterial pressure. It may generally be said that with a moderate maximum pressure for the age of the patient, and with a sufficient allowance of some 40 mgrs. between the maximum and the mean pressures, the cardiac function is effectually performed. In cases of mitral regurgitant disease the pressure is, as a rule, lowered. But it must be remembered there is nothing "ca' canny" about the heart; it can be trusted to deliver the uttermost output it is capable of, and the tendency is to an excessive effort beyond the actual need of the impediment. In aortic regurgitation the maximum pressure is high, the medium pressure relatively low, i.e. the pulse pressure is increased.[5] Probably the peculiar distress that precedes the appearance of dropsy in many heart diseases, especially mitral regurgitation, is associated with a high diastolic with relatively low systolic pressure, the onset of dropsy relieving pressure and restoring the effective balance of pulse pressure.

I have gone somewhat fully into the conditions which may attend and have a causative relationship to altered blood-pressure, so that little need further be said upon

symptomatology. Languor, headache, breathlessness on exertion, a certain sense of fullness behind the eyes, insomnia with undue pulsation of heart at night, occasional epistaxis, or other spontaneous mucous hæmorrhages, are amongst the few symptoms for which moderate degrees of high pressures are directly accountable.

Blood-pressure is, however, sometimes so excessive as to give rise to urgent symptoms which require immediate relief. Such symptoms may occur at any time with a range of pressure of 180 or higher. Severe epistaxis, or bronchial hæmorrhage, temporary asphasia, coma, or actual cerebral hæmorrhage, are not infrequent occurrences. Acute œdema of the lungs and threatened heart failure with anginal symptoms are also amongst the grave direct results of excessive pressure. A great temporary excess of albuminuria is sometimes observed.

The line of treatment of disordered arterial pressure is, for the most part, sufficiently indicated by the conditions I have enumerated as underlying the symptom. Its discussion at any length is beyond the scope of this article.

An efficient calomel and saline purge is indicated in any threatening of direct symptoms, and an occasional mercurial with intervening saline laxatives should be given. Vaso dilators should be avoided unless it be for the occasional relief of headache or insomnia by aspirin and phenacetin. It must not be forgotten that hypertension is often the means of maintaining organic function. This is especially the case in chronic nephritis, and must be taken carefully into account in treatment.

The treatment of any serious case should begin with a period of complete rest on a milk diet. The régime of life must be carefully overhauled and corrected. A course of Nauheim baths, with massage, may be

advised, especially when capillary circulation appears at fault, but only after a preliminary treatment by restricted diet and purgatives. The baths at Aix-les-Bains, Nauheim, Llandrindod Wells, and Woodhall Spa may be mentioned amongst those suitable in such cases.

For such urgent and dangerous occurrences as coma, severe bronchial hæmorrhages, or acute œdema of lungs, prompt venesection is called for. Epistaxis should be encouraged rather than checked, within reasonable limits. In cases in which fibrosis of the kidney is distinctly recognized, the question of decortication of the kidney is important for consideration.

When anginal symptoms are associated with pulmonary œdema a moderate dose of morphine with atropine is very useful.

Let me repeat with emphasis: Increased intra-arterial pressure is a symptom, not a disease, although, like other symptoms, it may become so predominant as to require direct interference. It must be regarded in due co-ordination with all other symptoms of organic unsoundness or ill conditions of life, of which it is often the first danger signal. In many cases its direct effect is compensatory, sustaining function under difficulties, and so it must rarely be isolated for attack in treatment.

References.

[1] Some authors regard the minimum as the diastolic pressure, but practically the minimum recorded, whether estimated by the auditory method or the character of needle fluctuation, is higher than that at which pulsation first appears. [2] A full description of all modern methods is given in Dr. Halls Dally's book on "High Blood Pressure," 1923. He also gives full references to the literature. Faught and Oliver are the classical authorities on the subject. [3] Lord Dawson: Paper read at the Bath meeting of the British Medical Association (*B. M. J.*, Aug. 1895, p. 197). [4] A lecture on The Rôle of the Cardio-Vascular System in Pulmonary Tuberculosis delivered at the Brompton Hospital (*Lancet*, 1912, p. 1415). [5] "On Aortic Regurgitant Disease with Reference to Insurance Cases," THE PRACTITIONER, May, 1923.

Examination of the Heart by the Electro-Cardiograph.

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IT is generally agreed that within recent years there has been a great advance in our knowledge of cardiac disorders, and this advance has been of so practical a character and of such vital importance with regard to diagnosis, prognosis, and treatment, that it is the duty of every clinician to make himself acquainted with its nature and scope. Three examples of this may be cited:

(1) The subject of irregular action of the heart in persons who may or may not exhibit evidence of organic heart disease has been notoriously a source of perplexity and difficulty to the clinician, for it was known that this in itself might, on the one hand, signify definite and even serious impairment or disease of the heart, or, on the other hand, that it might be of no practical importance. We are now able to classify almost every case of irregular action of the heart into types, and we know what each signifies, so that when a patient exhibits it we can, with confidence, form an accurate opinion of his case.

(2) Another problem has been the extraordinary difference in the results of the administration of digitalis, or one of its allies, in persons who are suffering from identically the same lesions, and complaining of precisely the same symptoms. It is of great importance to the practitioner to realize that this problem has been

to a great extent solved. Put briefly, those cases of cardiac failure which show wonderfully good results are, in the vast majority of instances, cases of auricular fibrillation, or of auricular flutter, in either case accompanied by a rapid ventricular rate.

(3) The third example is with reference to cardiac failure. It is agreed that the essential cause of this lies in the heart muscle. Now, if this view be correct, valvular defects, diseased conditions of the blood vessels, and disturbances of the cardiac mechanism should be regarded from the point of view of the relation which they bear to the myocardium, rather than as specific affections in themselves. It should always be remembered that there are as a rule along with the valvular lesion coincident changes in the cardiac musculature. In all cases of valvular disease, therefore, it is of the utmost importance that we should endeavour to ascertain whether the lesion which has invaded the valve has also affected the myocardium, and to what extent, and whether the lesion which is present is progressive. There has been a marked increase in the means at our disposal within recent years.

The great advance in our knowledge of cardiac disorders has been mainly due to the introduction of the clinical polygraph and the electro-cardiograph in the examination of the cardiac mechanism.

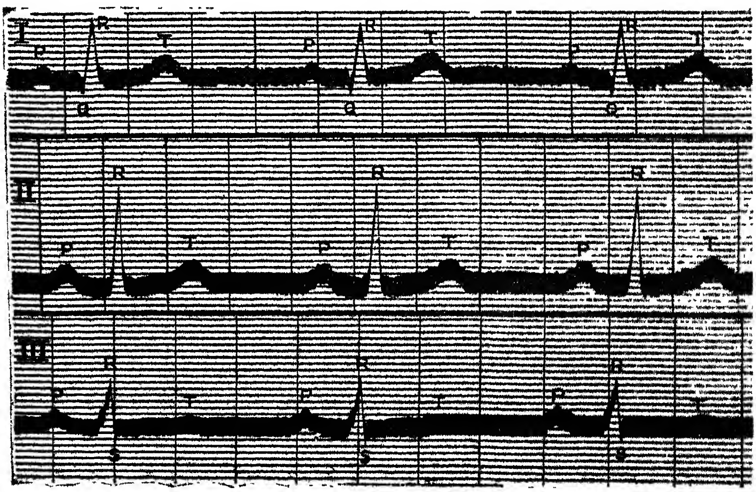
It may at this stage be advisable to mention briefly some anatomical and physiological considerations. That part of the auricle which is situated at the junction of the chamber with the great veins is called the sinus part. In it there is a small node of specialized tissue, called the sino-auricular node. There is another small node of specialized tissue situated in the septal wall of the right auricle; this is called the auriculo-ventricular node. Leading from this node is a bundle of tissue connecting the auricles and the

ventricles. It passes forwards in the inter-auricular septum, divides into two branches, the right and left septal divisions, one of which goes to the right and the other to the left ventricle, each ending in the ventricular musculature by widespread subendothelial ramifications—the Purkinje fibres. When the heart is going to contract, the stimulus for contraction arises normally at the sinus, and there is reason to believe that it begins in the sino-auricular node. From this point the stimulus spreads rapidly over the auricles, and auricular systole takes place. It then travels through the auriculo-ventricular node, along the auriculo-ventricular bundle, its two main branches and their subendothelial ramifications, and is thus distributed to the ventricles, the ventricles contracting only in response to stimuli received from the auricle. But while normally the stimulus for contraction rises in the sinus part of the auricle, if any other portion of the heart becomes more excitable the stimulus for contraction arises at this point. The stimulus for contraction is conveyed from fibre to fibre by means of a specialized function of the cardiac muscle-fibres called conductivity.

By means of the clinical polygraph we are able to obtain records of the movements of both auricles and ventricles. We are also able to measure the function of conductivity of the auriculo-ventricular bundle above its division into two branches. The clinical polygraph often affords — directly, or by inference — valuable information regarding the state of the myocardium.

It has been known for a considerable time that changes in electrical potential take place in the muscle when it contracts, and, further, that a record of these changes may be obtained by connecting the muscle with a sensitive galvanometer by means of electrodes. A. D. Waller, in 1887, employed a capillary electrometer to register the changes in electric potential in the human heart during contraction. He demonstrated

that these changes were distributed through the body, and he used the moist skin surfaces of the arms and legs as leads, connecting them with a galvanometer. Einthoven employed the string galvanometer to register the changes in electric potential in the human heart. He modified this instrument, the Einthoven string galvanometer being now generally employed in physiological and clinical investigations. The record of the changes in electric potential which take place in the heart during contraction is called an electro-cardiogram. If a normal electro-cardiogram be studied, certain upward and downward deflections are seen in each cardiac cycle, the former being the more important. The first deflection, P, is due to the contraction of the auricles. Q, R, S, and T are due to the contraction of the ventricles. R and T are the most constant deflections, the former



more specially so ; Q and S are not infrequently absent. P is a small, blunt and rounded upward deflection. Q and S are downward, steep deflections, usually of small amplitude. Q passes at once into R, which is an upward sharp spike, and of greater ampli-

tude than any of the other deflections. If S be present it follows immediately upon R. T is a prominent, broad, blunt deflection. It is an upward deflection in lead II; it is almost always an upward deflection, but may be inverted, in lead I; and is not infrequently inverted in lead III. It is said that the inversion of T in lead II is always pathological, and in lead I nearly always so. If P or R be a downward deflection in lead I, II, or III, it is abnormal. The time-distance between the beginning of P and the commencement of Q, or between P and R, as the case may be, is a measure of the function of conductivity of the auriculo-ventricular bundle above its division into two branches; it is called the P-Q or P-R interval. The initial group of ventricular deflections (Q, R, S) corresponds to the initial events of ventricular systole—in other words, to the spread of the wave of excitation in the ventricular muscle. The period of time occupied by this group is of great importance, being a measure of the time during which the various parts of the ventricular muscle are passing into activity. It is normally not more than one-tenth second. If it is increased it indicates a delay in the conduction of the wave of excitation through the ventricular muscle. The period between the S and T corresponds to the time during which the main mass of the ventricular muscle is in contraction.

The form of electro-cardiographic curves depends upon the point of origin and path of conduction of the stimulus for contraction; any departure from the normal in respect of either of these will, therefore, result in a corresponding alteration in the form of the electro-cardiogram. A normal P signifies that the stimulus for contraction arises in the remains of the sinus venosus at the orifices of the great veins, and that from this point the stimulus spreads over the whole of the auricles in the usual manner. When P is abnormal,

as, for instance, inverted, it is believed that the contraction of the auricle has commenced at some site other than the sino-auricular node.

As in the case of the clinical polygraph, by means of the electro-cardiograph we are able to obtain records of the movements of both auricles and ventricles, and also to measure the function of conductivity of the auriculo-ventricular bundle above its division into two branches. In addition, it tells us the point of origin and path of conduction of the stimulus for contraction, and also affords information of the function of conductivity of the auriculo-ventricular bundle *below* its division into the two main branches—that is, after its entrance into the ventricular muscle.

All cases of cardiac irregularity, apart from comparatively rare exceptions, fall into one of six groups: The so-called sinus irregularity; irregularity due to premature contraction or extra-systole; irregularity due to heart-block; irregularity due to alternation of the heart; irregularity due to auricular fibrillation; and irregularity due to auricular flutter. A diagnosis of sinus irregularity may be made by auscultation, or by a study of a sphygmogram, or by a polygraphic or electro-cardiographic record. In the great majority of cases of extra-systoles a correct diagnosis can be made simply by palpation and auscultation. They may be recognized with certainty by means of the clinical polygraph or the electro-cardiograph. The first grade of auriculo-ventricular block can only be recognized by means of either the clinical polygraph or the electro-cardiograph, and this applies to a large proportion of the other grades. In this connection it is important to note that the occurrence of partial heart-block during the course of an acute infective disease is a sign, and may be the only sign, of myocardial involvement; and that digitalis is contra-indicated in the first two grades of partial heart-block. A

lesion of either the right or left main branch of the auriculo-ventricular bundle, and also defective conductivity of their subendothelial ramifications, can be recognized by means of the electro-cardiograph alone. This is of the utmost importance as affording information of the condition of the myocardium. The prognosis in the case of the first is usually very unfavourable, and in the case of the second it is almost always grave. In the great majority of cases of alternation of the heart it is necessary to take a tracing of the radial artery or an electro-cardiogram. When alternation occurs apart from severe tachycardia, it is an indication of extreme exhaustion of the heart muscle. We may be reasonably certain of the existence of auricular fibrillation from the mere presence of complete irregularity of the pulse. The condition can be diagnosed with practical certainty on polygraphic examination, and with absolute certainty on electro-cardiographic examination. The diagnosis of auricular flutter is usually impossible without the employment of the polygraph or electro-cardiograph, and frequently a correct diagnosis cannot be made with certainty even though the former instrument be employed, an electro-cardiographic examination being necessary. The diagnosis of paroxysmal tachycardia can usually be made without instrumental means, and in a still larger proportion with the aid of the clinical polygraph; but by means of the electro-cardiograph it is possible to diagnose all cases, and also to ascertain the site from which stimuli for contraction arise in each case.

The electro-cardiograph only occasionally offers help in the diagnosis of chronic valvular disease. In mitral stenosis the amplitude of the deflection P is often markedly increased. While this is especially so in mitral stenosis in which there is hypertrophy of the auricle, in my opinion it is not justifiable to diagnose the lesion from this alone. Not infrequently the de-

flection P is broad, has a flat top, and is bifurcated. These features, when present, are of diagnostic value. It is said that an increase in the amplitude of the deflections is often found in congenital heart disease. This does not agree with my experience. In transposition of the heart all the deflections of the curves from lead I are inverted. This is the most valuable diagnostic sign at our disposal.

Recently, quinidine sulphate, administered by the mouth, has been employed in the treatment of persistent auricular fibrillation, and of persistent auricular flutter, with the object of restoring the normal rhythm. If this method of treatment is adopted, frequent electro-cardiographic or polygraphic examinations, preferably the former, are advisable, as the drug should be stopped if the auricular rate falls to 250 or 240 per minute—because of the risk of inducing 1 : 1 rhythm, or, as a rule, if the ventricular rate rises above 160.

It will thus be seen that clinical electro-cardiography affords the best method of investigating disordered cardiac mechanism, and, indeed, is frequently essential. It gives evidence of left- or right-sided preponderance when either exists, it is occasionally of value in the diagnosis of chronic valvular disease, it contributes the most certain sign of transposition of the heart, and is a valuable aid in quinidine therapy. Most important of all, it is the most precise means at our disposal of investigating the functional efficiency of the all-important heart-muscle itself. It may be confidently stated that in our study of cardiac disorders the electro-cardiograph gives us fuller information in the vast majority of cases, that this information is important in a large proportion, and not infrequently is indispensable.

The Use of Test-Meals and Duodenal Tubes in Diagnosis.

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THE analysis of the contents of the stomach removed at one or more definite intervals after the ingestion of a "test-meal" gives one some idea of the secretory and motor activities of the stomach and, perhaps, more nearly of the functioning of the pyloric mechanism. The information so obtained is often of use in diagnosis, but is of even greater use in affording direct indications for a rational treatment.

Test-meals varying in complexity and elaboration have been employed at different times by different observers, but to-day two only are at all generally used, namely, the test-breakfast of Ewald, and the gruel-meal of Rehfuss. The test-meal must be given in the morning at 8 a.m. or 9 a.m., on the empty, fasting stomach, and in either case the emptiness of the stomach must be assured by the passing of a stomach-tube immediately or some short time before the ingestion of the meal, and any residual contents removed, and in case of any doubt the stomach should be further washed out with warm water. The residual stomach-contents so obtained frequently provide important diagnostic information.

A large quantity, say 200 c.cm. or more, would suggest some degree of pyloric obstruction, as also would the presence of debris of some particular food taken a day or more previously. The characters of

the material might indicate the nature of the obstruction; a clear or slightly-turbid, yellowish acid fluid would suggest inflammatory stenosis, whereas a grey or brown stinking, rancid, turbid fluid, depositing a grey or brown granular debris, and surmounted by a layer of froth, would be significant of cancer. Any brown granular detritus, superficially suggestive of "coffee grounds," should be tested for blood pigment by acidifying with acetic acid, extraction with ether, and the application of the guaiacum or benzidin tests.

The presence of slimy, ropy material, difficult to evacuate, is characteristic of chronic catarrhal gastritis, a condition commonly diagnosed, but not commonly seen. Small masses of mucus or muco-pus floating in the residual contents have been swallowed, and point to some naso-pharyngeal lesion.

1. *The Ewald Test-breakfast, or One-hour Meal.*—This long-established test consists of one pint of freshly-infused tea without milk or sugar, and a roll of white bread, or preferably four breakfast biscuits. The meal should be taken deliberately, and the biscuits well masticated, or, if the teeth are defective, soaked in the tea and triturated with the tongue. Exactly one hour after the ingestion of the meal, a small pliable stomach-tube, free from cracks, and of the velvet-eye type, well wetted with warm water, is passed to the fundus, as indicated by a mark on the tube, and as much as possible of the stomach contents is withdrawn, either by an evacuating bottle or by siphonage, and the amount measured. A small amount, 30 c.cm. or less, will indicate rapid emptying of the stomach, as in certain cases of duodenal ulcer and other forms of reflex dyspepsia, and in achylia. A large amount, on the other hand, will point to delayed emptying, either from pyloric stenosis or spasm. The normal amount which can generally be withdrawn is from 50 c.cm. to 80 c.cm. The material is then filtered; the presence of

bile, as shown by the characteristic colour, and of blood, is noted. In the filtrate the presence or absence of free HCl is determined either by a drop of Töpfer's reagent (an alcoholic solution of dimethylamidoazobenzol), a yellow solution which turns cerise by free mineral acids, or by Günzberg's test (phloroglucin-vanillin). The acid values—namely, the free HCl and the total acidity—are estimated by titration with $\frac{N}{10}$ caustic soda, Töpfer's reagent and phenolphthalein respectively being the indicators. These values vary within relatively wide limits in the normal stomach, namely: free HCl, 20 to 40; total acidity, 40 to 60. The figures are the amount of $\frac{N}{10}$ caustic soda in c.cms. required to neutralize the free HCl, and the total acidity respectively in 100 c.cm. of stomach contents. A considerable experience has shown that the diagnostic utility of the Ewald test-breakfast is limited, but that the results may be highly suggestive.

Considerable variations occur in the acid values in the same individual due to variations in secretion of nervous origin, and in an investigation made some years ago I endeavoured to eliminate this as far as possible by taking the average of three consecutive daily observations.

The results then obtained showed that the highest acid values occurred in cases of juxta-pyloric ulcers, the free HCl value ranging from 60 to 95, the latter figure occurring in a case of duodenal ulcer with rapid emptying; in reflex dyspepsias of appendicular and uterine (fibroids) origin free acid values of from 40 to 60 are the rule, whilst in reflex gall-bladder dyspepsia the free acid values are generally within normal limits. Similarly, in chronic ulcer on the lesser curvature in the body of the stomach the acid values are within the normal limits, which would indicate that the ulcer *per se* is not responsible for the high acid values found when it is juxta-pyloric in position. In cancer of the

body of the stomach disappearance of free HCl from the stomach contents is an early and important phenomenon, and when this is associated with the presence of blood, and maybe, of lactic acid, as shown by Uffelmann's reagent, it is of profound diagnostic significance. In pyloric cancer, on the other hand, free HCl may be detected ranging up to ten in the earlier phases of the disease.

In pernicious anæmia free HCl is commonly absent, the total acidity being low, and occasionally one meets with an apparently normal individual with a similar achlorhydria.

An absence of free HCl with an excess of mucus is met with in some cases of catarrhal gastritis; but it is the excess of mucus that is significant.

2. *The Fractional Test-meal of Rehfuss.*—Since 1914 this has been the most generally employed method for investigating gastric disorders, and while the results obtained have elucidated in many ways the physiological mechanism of the variations in the composition of the gastric contents in pathological conditions, the actual diagnostic importance of variations in the acid values of the stomach contents remains much the same.

A Rehfuss tube, or some modification of it as that devised by Ryle, is passed into the fasting stomach, and the residual, or resting, contents are sucked out by a Record, or similar, syringe attached to the free end of the tube; and then, the tube remaining *in situ*, a pint of warm gruel is swallowed by the patient, the gruel being made by boiling two tablespoonfuls of fine oatmeal in a quart of water until the bulk has been reduced to one pint, and strained through muslin. Salt should not be added. After fifteen minutes 10 c.cm. of the stomach contents are withdrawn by the syringe, and placed in the first of a series of numbered test-tubes, and a similar quantity is withdrawn at fifteen-minute intervals until the stomach has been

evacuated, the several samples being kept in proper sequence in the numbered tubes.

The examination of the residual, or resting, stomach contents and its significance has already been dealt with.

In each of the sequence of samples of test-meal withdrawn from the stomach, the presence, or absence, of starch is determined by the addition of iodine, of bile by its characteristic colour, and of blood similarly, and of mucus by its tenacity. In each the values of the free HCl and total acidity are estimated as before. The results are then plotted on a squared chart, and give a characteristic curve, the features of which are: the acid value increase in each sample until a maximum is attained in 1¼ hours and then abruptly fall in each further sample until the stomach is empty, the fall being marked by the appearance of bile in the samples. The disappearance of starch marks the time at which the food has left the stomach, and is a measure of the rate of emptying.

The acidity curve which varies in the normal stomach within fairly wide limits is not a curve of gastric secretion, but is more nearly a representation of the motor mechanisms of the stomach.

The rising acidity is the result of the continuous addition of gastric juice having a constant acidity of 0·42 per cent. to a stomach contents which is continually diminishing in volume by passing into the duodenum; the fall in acidity marks a new factor, namely, the reflux of alkaline duodenal contents into the stomach, and the secretion of an alkaline fluid by the pyloric mucosa which neutralize the acid, and this proceeds either continuously or with intermissions until the stomach is empty.

In certain cases of duodenal ulcer with rapid emptying of the stomach (duodenal hurry) the characteristic curve shows a steep rise to an abnormally high acid

value with or without a slight fall in the last sample or two, and the disappearance of the stomach contents an hour or so before the normal.

In pyloric obstruction the rise in acidity is more gradual, and is maintained until the stomach has been evacuated through the tube after some three to four hours; where the obstruction is inflammatory the acid value will be high; in neoplastic obstruction the secretion of gastric juice, if it occurs at all, is much reduced and the curve shows a slight and gradual ascent. The absence of free HCl in all fractions of the meal met with in many cases of pernicious anæmia, if it should prove to be a constant phenomenon of that disease, will be of diagnostic utility in differentiating it from certain cases of cancer of the body of the stomach where a low or negative free HCl value is associated with a higher total acidity curve.

3. *Investigation of the Duodenal Contents.*—If the Rehfuss tube is passed farther into the stomach—to the duodenal mark on the tube—the bulbous end will, after a time, pass through the pylorus into the duodenum. If, on withdrawing some material by the syringe, this is found to be alkaline and bile-stained, it is known that the end of the tube is in the duodenum.

The injection of from 50 c.cm. to 100 c.cm. of a 25 per cent. solution of magnesium sulphate into the duodenum causes evacuation of bile from the gall-bladder and bile ducts—the first sample withdrawn after five minutes being from the ducts, the second sample is more viscid and is from the gall-bladder, and, finally, a thin watery bile is withdrawn from the liver (Lyon). It is thus possible to make bacteriological and microscopic investigations of the duodenal contents, and of the contents of the several areas of the biliary tract, but as yet the method has not been utilized sufficiently widely to establish its diagnostic importance.

The Value of Blood and Urine Examination in Renal Disease.

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IN nephritis the destruction of active renal substance ultimately results in a condition in which the kidneys are no longer able to perform their normal functions. It must be clearly understood, however, that comparatively advanced renal disease may be present, and yet the kidneys may function so adequately that but little evidence of any pathological lesion may be found on clinical examination of the patient. Within certain limits the diseased kidney may perform quite satisfactorily all the functions of the healthy organ, but in order to do this certain changes in the blood must take place, and it is in the chemical detection of these changes that we look for evidence of renal disease when we examine the blood in nephritis. Long before any blood changes take place, evidence of renal inadequacy may be detected by the examination of the urine, but the most satisfactory evidence as to the condition of the kidneys is obtained when the results of blood and urine examination are compared and correlated.

The Blood in Nephritis.—Normally the waste products of protein metabolism accumulate in the blood and are excreted in the urine. The chief of these products are urea, uric acid, and creatinin; they all contain nitrogen in their molecule and they are

responsible for a small fraction of the total nitrogen of the blood. This fraction is generally referred to as "non-protein nitrogen." Now, when there is a difficulty in excreting these bodies, their concentration in the blood tends to increase. Each individual body can be estimated, and its concentration in the blood determined, but it is more convenient in practice to estimate the urea only, or to estimate the nitrogen of the whole group together. The amount of urea present acts, in a general way, as an indication of the concentration of the other bodies; if the amount of urea is high the other bodies are also high. The estimation of blood urea is, therefore, usually carried out in the examination of renal patients, and much importance is generally attached to the concentration of this substance as an index of renal inefficiency. The blood urea alone, however, cannot always be relied upon to furnish reliable information as to the state of the renal function, and far too much importance is often attached to it. When the circumstances permit of this estimation being accurately carried out, the result obtained will often prove useful, but experience is necessary in its interpretation, and wrong conclusions are sometimes drawn. This depends on the fact that an increase of blood urea is not necessarily an indication of renal deficiency. Many extra-renal conditions, such as cardiac disease, excessive diarrhœa, gastro-intestinal derangements, deep-seated abscesses and metabolic disturbances of various kinds may increase the blood urea. A high blood urea is, therefore, *per se* not a necessary indication of defective kidneys.

The mechanism by which the kidney excretes urea is at present unknown, but the renal cells possess to a very extraordinary degree the power of concentrating urea from the blood into the urine. The blood of a normal healthy subject contains, say, 25 milligrams of urea per 100 c.cm., and from this dilute solution the

kidney forms urine which may contain up to 2,000 milligrams per 100 c.cm., or even more. Thus the normal kidney concentrates urea from seventy to a hundred times. In nephritis this function is materially disturbed, so that in severe renal lesions the factor may amount to 2 or less. In such cases the amount of urea in urine is only twice that in the blood. This so-called *urea concentration factor* provides valuable information as to the state of the renal function.

When a formerly healthy kidney begins to fail a point soon arrives at which some difficulty is experienced in excreting the necessary amount of urea and other waste products. To overcome this difficulty an increase in the "head" of these bodies in the blood takes place. Thus the blood urea which was normally 20 milligrams per 100 c.cm. rises to, say, 30 milligrams per 100 c.cm. With this increased "head" in the blood the kidneys are able to excrete as much urea per day as they did before when the blood urea was only 20 milligrams. As the disease progresses a larger and larger "head" of blood urea is necessary, but during the whole time of this gradual increase in blood urea the total excretion of urea in the twenty-four hours remains the same. When the destruction of renal substance reaches a point at which even a very high blood urea "head" does not result in the excretion of the usual daily amount of urea, this product accumulates rapidly in the body, and death soon takes place. There is no increase in blood urea until about three-fourths of the normal kidney substance is rendered functionless; it is, therefore, obvious that any information derived from blood urea estimation is confined to comparatively advanced cases of renal disease. Early lesions show no change whatever in blood urea or other nitrogenous waste products.

The Urine in Nephritis.—It is a commonplace that albuminuria accompanies nephritis, but it is not so

well recognized that severe and progressive renal disease may be present without any protein appearing in the urine. In a group of more or less severe renal cases investigated by me some time ago, 5 per cent. showed no albuminuria, and yet in several of these the renal condition was practically hopeless.

Albuminuria may, or may not, indicate the presence of kidney disease. It is present in about 3 to 5 per cent. of normal healthy adults. Not uncommonly a patient who has had acute renal disease many years before may still pass protein in the urine, and yet show no evidence whatever of any renal inadequacy. Generally the presence of albumin in the urine of a patient who had acute nephritis ten or fifteen years before would be taken as evidence of a chronic progressive lesion, but this is frequently quite a wrong conclusion. Many patients continue to pass albumin for very many years after an attack of acute nephritis, and yet functional tests prove that no evidence of nephritis is present. Such patients generally worry a great deal over their condition and think they have renal disease, when, on the contrary, their kidneys are functioning perfectly. Whether albuminuria following acute nephritis is or is not associated with progressive kidney disease can always be settled by the use of modern functional tests.

One of the most important effects of renal disease is to reduce the concentration of urea in the urine. The examination of isolated specimens of urine is frequently of little value, but it may be said with certainty that if any casual specimen contains 2 to 2·5 per cent. urea or over there is very little the matter with the kidneys. Often it is difficult to say clinically whether a patient's symptoms are uræmic or due to some other cause. A patient suffering from albuminuria may get an attack of influenza, and his symptoms may suggest uræmia to his medical attendant. Clinically it is frequently impossible to decide the matter, but simple

examination of the urine will often put the question beyond doubt. If the urine contains more than 2 per cent. urea the condition is quite certainly not uræmic. Various diseases, such as encephalitis lethargica, give rise to similar difficulties. Perhaps one of the most notorious mistakes is that not infrequently made in confusing the intestinal symptoms of uræmia with intestinal obstruction. Examination of the urine for albumin gives practically no help, for this substance may be present in both conditions. The important point in all such cases is to estimate the urea in a sample of urine. If the concentration is high the condition is not nephritis, and the difficulty is solved.

In some cases of suspected renal disease, blood examination must be undertaken, and urea may have to be given by mouth in order to test the power of the kidney to concentrate, but in very many instances the simple procedure of estimating the urea in an ordinary specimen of urine will supply all the necessary information.

The value of modern functional tests in estimating renal efficiency is no longer doubted by anyone who has had any experience of them. It is now certain that a definite assessment of kidney efficiency may be obtained in all cases when a careful examination of blood and urine on the above lines is carried out. In very severe cases the clinical symptoms are so obvious that modern tests are superfluous, but in less severe conditions these tests are essential in order to obtain information on which to base prognosis and treatment. Their value in genito-urinary surgery has been amply established, and deaths from uræmia, after prostatectomy, should now be incidents of the past. In passing, I might state that occasionally the results of these tests are apparently at variance with the general condition of the patient; the patient's condition may appear excellent, while the tests may give

entirely unsatisfactory figures. In such cases experience proves, almost without exception, that the tests are more reliable as an index of the real renal condition than are the clinical symptoms and general condition. If this fact were more fully recognized in certain surgical procedures lives could sometimes be saved.

Though many of the functional tests employed are not very difficult to carry out, yet they demand a certain amount of manipulative skill. Estimation of the amount of urea in urine, however, is an extremely simple process which can be carried out by anyone in a few minutes. This simple procedure gives more information in general renal conditions than any other test at present employed. Instead of relying on albuminuria as an index of renal disease, the medical practitioner should get into the way of relying on urea concentration. It is not yet sufficiently recognized that the absence or presence of albuminuria affords but little evidence as to the condition of the kidneys. Many of our present views on the significance of albuminuria were formulated in days when kidney disease was not so well understood as it is now, and some of them are entirely erroneous. At least 50 per cent. of average individuals showing some albuminuria possess quite satisfactory kidneys. Again, the amount of albumin present is of little significance, except in acute disease, so that estimation of this product is usually superfluous. Further, it is very generally accepted that the particular kind of diet taken is not without influence in cases of albuminuria, and that the amount of albumin passed is decreased when protein is eliminated from the diet. This, however, is but another error founded on defective observation; no variation in diet protein produces any effect on the amount of albumin excreted in the urine.

Skin Reactions in Asthma, etc.

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THERE is a group of illnesses which, for want of a better term, have been called protein idiopathies.[1]

The following is a list of their manifestations: Asthma; Paroxysmal Rhinitis, such as Hay Fever; Animal Sensitiveness, such as Horse Asthma; Food Sensitiveness, such as Egg-Sickness; Urticaria; Eczema; Ichthiosis; Migraine-headaches; Epilepsy; Angio-neurotic Œdema; Paroxysmal Arthritis, Colitis, or Nephritis; etc.[2]

All these protein idiopathies are characterized by a peculiar and specific sensitiveness to one or more foreign proteins. The purpose of this article is to describe skin-reactions which may assist in the detection of this characteristic sensitiveness, and so of the disease produced thereby. However, in view of the reams of misleading literature produced on this subject, I want to make it quite clear to the practitioner that most of these protein sensitivenesses can *not* be tested for successfully, and many when detected are insignificant. Nevertheless, it is of great importance to understand the uses as well as the limitations of the method.

TECHNIQUE OF SKIN REACTIONS.

The generally employed method of skin-reaction is

[1] "Protein Idiopathies": see *Proc. of Roy. Soc. of Med.*, 1925, vol. xviii, pp. 29–32. Previously called "Toxic Idiopathies," see *Proc. of Roy. Soc. of Med.*, 1920, vol. xiii, pp. 129–148.

[2] This list might easily be lengthened. Also in addition to definite clinical entities, like hay fever, which are always protein idiopathies, it includes mere symptoms, like urticaria, which might be caused by, say, stinging nettles, or the blow of a whip.

conducted as follows: For preference, test men on the flexor surface of the forearm; women and children on the extensor surface of the thigh, just above the knee. (If any cleaning of the skin is considered necessary, soap and water are preferable to an antiseptic.) With any sharp sterile instrument, e.g. a stiff hypodermic needle, scratch through the superficial dead layer of the skin till the red cutis vera is laid bare, but avoid drawing blood.

A series of small areas, two to three millimetres square, must be scratched in this way, the number being at least one more than the number of tests to be made. The different protein reagents are then brought into intimate contact with the cutis vera on the different sites, one site being left untouched as a control. If the reagent is a fluid, it is sufficient to drop it on the scratched area; if it is a dry solid, it may be rubbed into the scratches with any blunt instrument, e.g. the wrong end of a match, or dissolved in a slightly alkaline saline solution, and so dropped on to the scratch. If the protein is caught and dried on filter paper (a favourite method of mine) it may be stuck on to the scratched area with a drop of alkaline saline, after the manner of a child's "transfer" picture.

After the protein reagents have been in contact with the tissues for about five minutes, the scratched areas should be cleared up wherever necessary with swabs of wool and a little water, removing any blood, traces of reagents, paper, etc., which might obscure the reaction. This usually begins in about seven minutes with an erythematous blush, which surrounds the scratched area; following this an urticarial weal starting at the scratch, but spreading beyond it into the surrounding skin. If the reaction is strong, the urticarial weal may extend for an inch or more beyond the scratched area, sending out characteristic pseudopodia beyond even that. Usually, however,

and with most types of protein, the urticaria is much less, and may not extend beyond the scratched area. The reaction is at its height in fifteen or twenty minutes, and is usually fading rapidly in half an hour. We take as a positive reaction either a *definite erythematous blush*, or a *definite urticarial weal*, or, better still, both of these together. Complete absence of any reaction (or a much slighter one) on the control site will prevent mistakes arising from dermographia, etc. If the reagent is an unknown one, e.g. extemporized by the practitioner (see below), it should be tested on the skin of a normal man, to make sure that it is not a general irritant.

The following are accessory or confirmatory methods:

1. The *intradermal:* 0·2 c.cm. of the reagent in fluid form (which must also be sterile) is injected into the thickness of the skin through a fine, sharp needle. This gives a *more marked erythema and urticaria* than is given by the dermal method, and so may be used in confirmation of a doubtful reaction. But if the patient is very sensitive to the reagent, he may easily receive a severe and widespread shock from the portions of the reagent which have joined the blood-stream via the lymph.

2. An *ophthalmic reaction* may be obtained by dropping the reagent into the conjunctival sac. This reaction also is more delicate than the dermal reaction, and quicker to come up (three to five minutes). But only one such reaction can be performed, since the other eye must be kept as the control. Also the patient may possibly be given an uncomfortably sore eye. A slight ophthalmic reaction is shown by a *tickling of the inner corner* of the eye, and a *reddening of the caruncle.* A stronger reaction will produce *sneezing, considerable irritation* and *reddening of the entire conjunctiva.*

3. *Reaction by proxy* may be carried out in the

absence of the patient, if his serum can be obtained. The serum is separated off from the clot, and say 0·5 c.cm. is injected intradermally into the skin of some presumably normal person (e.g. the investigator). The reagent to be investigated is then tested on this "sensitized" area either by the dermal or preferably by the intradermal method, when a typical local reaction may be obtained. Or the reagent, if sufficiently harmless to the normal person, may be injected into the blood-stream of the sensitized normal person, and now a positive reaction will take on more the appearance of a temporary *angio-neurotic œdema* at the sensitized area. This method has inherent limitations, but I myself have usefully employed it in clinching a diagnosis of hay fever by serum sent through the post.

WHAT PROTEINS MIGHT WE USEFULLY TEST FOR ?

Whenever the results of a protein idiopathy are detected clinically (e.g. asthma, epilepsy, angio-neurotic-œdema, etc.) it is desirable to detect the protein causes, *if we can*, by means of the skin reaction. But because all the hundreds of thousands of proteins of the animal and vegetable kingdom might conceivably be acting as irritants, it is clearly impossible to test at random. It is necessary to find out what types of proteins are at all likely to be at fault. Occasionally the patient can tell you straight away that he has, e.g. hay fever, horse asthma, egg-sickness, etc., and it is only necessary to confirm this by a direct test with, in these instances, grass pollen, horse dandruff, and white of egg respectively. Frequently, however, the patient can give no direct help, and it is highly necessary to get a clear idea as to what proteins to test for, by thorough preliminary cross-questioning. There is no space here to give any such questionnaire (which may very well last for an hour or more), but as samples of questions pointing to particular proteins I might

instance: In what month of the year do the attacks come on? At what hour of the day? In what districts, etc.? The majority of proteins cannot be tested for, or very doubtfully. These include all the infecting bacteria, e.g. in bronchial or intestinal asthma; also all the spores of moulds and higher fungi, and this field is too vast to have been worked out as yet by the botanists.

WHAT PROTEIN REAGENTS SHALL WE USE?

The reagents should be chemically identical with the foreign substances which are causing the symptoms in the patients; these various animal and vegetable substances need no preparation to make them produce a skin reaction. Any "preparation" of proteins will only be in the direction of making them keep well and for convenience in storage. If a man is food-sensitive a sample of the food in question will give a good reaction. Any grass pollen will detect hay fever in the same way. A general practitioner had better begin by investigating in a small way with reagents culled from the kitchen or the world at large; frequently, almost usually, reactions obtained in this way are more definite and easier to read than reactions obtained with substances bought from a wholesale chemist. I, myself, have obtained sharp diagnostic reactions with the "home supply" protein on a patient who had given no reaction at all with proteins bought from a number of the best-known wholesale chemists; but in dealing with a reagent previously unknown to him, the investigator must remember to test it on a normal person first, as explained under the heading of technique.

The expert on this subject who may wish to test a number of patients at a moment's notice must, however, fall back on a set of proteins. A number of such sets are on the market put up as well as they can be for keeping, and there is not much to choose between them. Or he may prefer to make some at least of his own

preparations. There is one direction in which the "set of proteins" has the advantage. Groups of proteins from various sources can be mixed together into one reagent in order to test for a group of protein idiopathies, e.g. scurf from the skin of all the common domestic animals; proteins from all the commoner meat substances; all the farinaceous foods, etc. But it will be found that it is seldom of any use to test completely at random in this way.

WHAT DOES A POSITIVE OR NEGATIVE SKIN REACTION MEAN?

If *no* reaction is obtained, this may be because the person is not sensitive to that particular reagent; but there may be other explanations. The reagent may have been spoilt in preparation; or it may belong to a group of proteins which give only slight or very doubtful reactions, e.g. the bacteria, moulds, and fungi in general, as mentioned above.

If a *positive* reaction is obtained under suitable controls, then the patient is sensitive to that particular protein, but this sensitization may be quite, or comparatively, unimportant as the cause of his illness.

Even after a dozen positive reactions have been obtained, there may yet be other and more important sensitizations which have not been detected or suspected. For example, it is no good to tell a man that his persistent asthma, urticaria, etc., is caused by eating—to take random examples—bananas, tomatoes or lobster, when the man has suspected and persistently avoided such food for years. It is useless to ascribe a rhinorrhœa in mid-winter to hay fever, merely because the patient shows a positive dermal reaction to the pollen of the grasses.

Here the significance is merely that the patient is liable to random protein sensitivenesses, and the important ones may be not easily tested for, e.g. microbic.

Skin Reactions in Diphtheria, Scarlet Fever, and Tuberculosis.

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SCHICK TEST.

IN 1907 Romer first used the intradermal reaction in guinea-pigs in carrying out virulence tests in diphtheria. This technique was supplemented by Michiels and Schick in 1913, who introduced the test known as the Schick Test, which has now been used clinically in many thousands of cases, in order to gauge in man the susceptibility or otherwise to diphtheria toxin.

It consists in inoculating into the skin of the subject a small measured dose of toxin, and observing what, if any, local reaction occurs. If no local reaction is produced, it is argued that the injected toxin has been neutralized by the patient's serum, and that the serum contains antitoxin, the amount of antitoxin being measurable by the amount of toxin injected.

The test is as follows:

The toxin is a six-day culture in sugar-free broth, filtered and allowed to stand 18 months to stabilize. The minimal lethal dose (m.l.d.) is estimated in the usual way. When required for the test a dilution is made so that one-fiftieth m.l.d. is contained in 0·2 c.cm. This diluted toxin must be used fresh, as it is not reliable after twenty-four hours. A part of the diluted toxin is heated to 70° C. for five minutes, and is used as a control. In the test, 0·2 c.cm. is injected very

carefully intradermally, using an inoculation syringe with a fine needle. The best site is the flexor aspect of the forearm. A small white wheal will arise showing pits caused by hair follicles and sweat glands. The control test is carried out on the corresponding spot on the other arm. A second syringe is used for this, and 0·2 c.cm. of the heated toxin is injected here.

Four types of reaction are obtained:

(1) *Negative.*—Both arms show after twenty-four hours nothing except a spot where the needle was inserted, or perhaps a small pink coloration, which soon fades.

(2) *Positive.*—The control arm is as in (1), but on the test arm, after twenty-four to thirty-six hours, a red flush begins to appear. It is half to one inch in diameter, and is at its maximum in four days, gradually fading into a brown discoloration on which small scales may appear. Pigmentation may remain for weeks. Occasionally the positive reaction does not appear until the third day.

(3) *Negative and Pseudo-Reaction.*—This is a red flush with dark centre, less circumscribed than the positive reaction. It develops rapidly in twenty-four hours, and is equal on both arms. It has mostly faded by the fourth day, and may leave behind pigmentation with a certain amount of desquamation.

(4) *Positive and Pseudo-Reaction* (combined).—The pseudo effect develops a red flush with deeper centre on both arms, and as this fades the positive emerges on the test arm as a much larger flush with a dark centre, which goes on to pigmentation and desquamation. The control reaction has meanwhile faded. The readings are most distinctive between the fourth and seventh days. The combined reaction is comparatively uncommon.

The patient is *Immune* if the reaction is Negative or

Negative and Pseudo.

The patient is *Susceptible* if the reaction is Positive or Combined.

Michiels and Schick estimated that after inoculation of their standard quantity of toxin (one-fiftieth m.l.d. in the test), that to give a negative reaction at least one-thirtieth unit of antitoxin per c.cm. was present. Much more antitoxin was often found even up to ten units. Later work shows that, as ordinarily carried out, Schick's Test reveals the presence of about one-fortieth to one-sixtieth unit of antitoxin per c.cm., and a negative case is assumed to have at least this amount to be immune.

The pseudo element in these reactions is not yet explained—suffice it to say that it is thought by some to be an "allergic reaction" owing to a previous sensitization to bacillary proteins in the toxin. It is inseparable from the toxin moiety even by fractional distillation and precipitation continued until 99 per cent. of the nitrogen present has been got rid of. It does not occur in animals.

TABLE I.

The Schick Test at Different Age Groups (Park).

Age.	Schick Positive. Per cent.
0– 3 months	15
3– 6 ,,	30
6–12 ,,	60
1– 2 years	70
2– 3 ,,	60
3– 5 ,,	40
5–10 ,,	30
10–20 ,,	20
Over 20 ,,	15

As regards susceptibility to diphtheria amongst children, it may be stated broadly that there is a certain passively transmitted immunity in infants under one year, due to inheritance of antitoxin from the mother; between two and five years there is a distinct loss of immunity, which increases again in children of school

age. This latter increase is no doubt due to the children acquiring small infections from their neighbours, not, however, in sufficient amount to cause disease, with consequent development of antitoxin in their systems.

Active Immunization is carried out by the injection of a toxin-antitoxin mixture of a definite strength. The usual dosage is three injections of one c.cm. at weekly intervals, and the Schick positive child is often by this means rendered Schick negative. Re-testing and, if necessary, re-inoculation may be done three or six months later.

As the toxin-antitoxin mixture has not proved safe in certain instances an important modification has been described by Glennie, Hopkins, and Pope, in which the diphtheria toxin is rendered non-toxic by the agency of formaldehyde. The toxoid-antitoxin mixture resulting is a very good immunizing agent, and is entirely atoxic to guinea-pigs.

Results from the Injection of Toxin-antitoxin.—Wholesale immunization of susceptible school-children has been carried out by Park, who, in 1922, published figures showing that of 90,000 Schick-tested, immunized, and treated school-children, fourteen got diphtheria, whilst of a similar number not tested or treated fifty-six got diphtheria. This showed a reduction in the number of cases of 75 per cent., and it is hoped that even better results will accrue as methods improve. Very good results are reported from Birmingham and Bristol in the immunization of hospital nurses. In London the Borough of Holborn is treating school-children in this country under the direction of Dr. Hutt.

In this country it has been found by R. A. O'Brien that in poorer class children 70 per cent. are Schick negative when of school age, whilst in a private school, where children are protected from infection and the resulting small doses of toxin, little or no "natural" immunity is developed, and so only about 30 per cent.

are found to be Schick negative. Further, where no natural immunity exists already as in the better class school-children, the "primary response" to inoculation is slow and feeble, whereas a similar dose will elicit a rapid and abundant production of antitoxin in those children who have already some antitoxin in their blood, even a minute amount ("secondary response").

Another application of the Schick Test is in the clinical diagnosis of diphtheria. A true case of diphtheria will have a positive Schick reaction. A carrier of virulent diphtheria bacilli will have a negative reaction.

DICK TEST.

This test is used to demonstrate susceptibility or otherwise to the toxin of scarlet fever in the same way as the Schick Test in diphtheria.

Briefly the theory is that scarlet fever is caused by the circulation in the blood of the toxin of a specific hæmolytic streptococcus. The microbe does not invade the blood-stream, but remains in the pharynx, or wound, or elsewhere, as in the case of diphtheria. The toxin causes the development of an antitoxin, and this is demonstrable in the serum of convalescents. Immunity is developed to this toxin, but not to the bacteria themselves, hence the occurrence of mastoiditis, abscesses, and other streptococcal manifestations as sequelæ of scarlet fever, even though the patient has recovered from the scarlatinal toxæmia.

The rash and fever are due to the toxin, and injection of the sterilized toxin will produce these symptoms in man, but will fail to produce them where antitoxic immunity has previously been produced by the disease.

The earliest work on this subject was reported by Moser in 1902. He isolated streptococci from the throats of scarlet-fever cases, and injected horses with

these living organisms together with the broth they were grown in. He thus obtained a curative serum and reported good results.

Savchenko in 1905 obtained a strong toxin from the filtered broth, and also a serum with both antitoxic and streptococcal bactericidal properties.

Gabritschewsky in 1907 vaccinated children successfully with a vaccine containing the toxin and bodies of streptococci obtained from scarlet fever.

The work of the Dicks, Dochez, Mervyn Gordon, etc. in the last two or three years has led us to appreciate this early work at its true value, which hitherto had gone almost unrecognized.

In October 1923 the Dicks first inoculated five volunteers with a streptococcus culture from a case of scarlet fever. One of them developed the disease. At the same time the throats of five others were inoculated with the filtrate of a broth culture. No disease developed. These five were then treated with the streptococcus culture, and one of them developed the disease. This showed that the active agent was not a filtrable virus attached to the microbes. The Dicks next worked at the toxin already discovered by Savchenko and Gabritschewsky, and the Dick Test was the result.

Dick Test.—The toxin is used in a dilution of 1 in 1,000, and is standardized by intracutaneous tests in a susceptible human being, as it has little effect on animals.

0·1 or 0·2 c.cm. of the dilution is injected intracutaneously, the technique being the same as in the Schick Test. The control is the same dilution of toxin heated for one hour in a water bath at 100° C., and this is injected into the other arm.

The reactions which result are much the same as in the Schick Test, including the occurrence of a pseudoreaction. The positive flush appears much earlier than

in the Schick Test, being at its maximum in twenty-four hours, and fading after forty-eight hours.

It is possible by methods described by Huntoon to separate most of the protein constituents from the toxin, so that fewer pseudo-reactions result in the Dick Test. The toxin is not a globulin but comes down with the higher albumin fraction and is digested by trypsin. As in the case of diphtheria, a toxoid is being prepared similar to that reported by Glennie and Hopkins.

Zingher has reported on 7,700 healthy persons of all ages tested by this test. There is a close similarity to the Schick Test in the percentage of positive reactions in the various age groups.

TABLE II.

The Dick Test at Different Age Groups (Zingher).

Age.	Total Tested.	Positive. Per cent.
0– 6 months	29	44·8
6–12 „	52	65·3
1– 2 years	233	71·6
2– 3 „	204	64·2
3– 4 „	241	60·5
4– 5 „	264	48·4
5–10 „	1,955	33·6
10–15 „	2,965	22·8
15–20 „	981	16·8
20 years up	776	14·4
Total	7,700	29·2

Infants under a year old show a much higher proportion of negative reactions than those between one and two years, presumably on account of transmitted antitoxin from the mothers. Zingher obtained antitoxin from the umbilical cords in four cases where mother and child were both negative. In two cases where no antitoxin was obtained, both mother and child were Dick positive.

In the lower-class schools about three times as many were Dick negative as in the higher-class schools.

The Dick Test is positive in patients suffering from the disease, for the first three days; it then gradually

diminishes and is negative at about the time of defervescence. Zingher holds that if a case diagnosed as scarlet fever maintains a strong Dick positive for seven or eight days, it is probably not scarlet fever.

The test is not so reliable as the Schick Test at present, and as R. A. O'Brien points out, in England only 70–90 per cent. of cases give a positive reaction with one-thousandth toxin.

Schultz Charlton Reaction.—If 1 c.cm. of a diluted convalescent serum be injected intradermally into the red rash of a scarlet fever patient, a blanching appears in an area several c.cm. in diameter. This result is due to the action of the antitoxin on the specific toxin of scarlet fever. The same result is obtained from the injection of antitoxic serum from the horse, and this reaction is one of the means used in the standardization of antitoxin.

Immunization.—An antitoxic serum has been prepared by Dochez and also by the Dicks. Good therapeutic results are reported, but large amounts of the serum must be given (40 c.cm.) and as early in the disease as possible. Antitoxin is useless after the rash has disappeared and has no effect on sequelæ due to sepsis. It is given intramuscularly in moderate cases, and intravenously in severe ones. A second dose may be necessary.

Active Immunization is carried out by the injection of toxin. The scarlet fever toxin is much less injurious to the local tissues than the diphtheria toxin, so that there is no need to add antitoxin. It is standardized according to skin doses worked out on a susceptible human. The most suitable dose varies with conditions, as less is given when epidemics are prevalent. This is because rashes may occur through the injection of the toxin, and so lead to confusion with actual cases.

The Dicks advise three doses, of 500 skin units for

the first, 1,500 for the second, and considerably more for the third.

Intradermal Cutaneous Reactions in Tuberculosis.—There is a considerable analogy between the tests already described and the Von Pirquet Reaction in tuberculosis. Von Pirquet, in 1908, described his method of abrading the mucous layer of the skin without drawing blood. Moro worked out a method of obtaining a cutaneous reaction on the skin by rubbing in an ointment of Koch's old tuberculin in lanolin. Mendel and Romer worked on the reaction of tuberculin injected intracutaneously.

But the drawback to all these tests in the human subject has been that of too great sensitiveness, and that the greater part of the population showed signs of susceptibility to the specific tuberculin.

The problem was to find a test by which activity of disease even in an early stage could be differentiated from the more common non-active or passive stage.

Working on the assumption that the amount of activity of the disease present at any time is reflected in the degree of tuberculin sensitiveness demonstrable, several attempts have been made to devise a quantitative cutaneous tuberculin test, notably by Ellermann and Erlandsen, White and Van Norman, Morland, and Ellis.

Ellermann and Erlandsen's method as modified by Morland consisted in the use of four dilutions of old tuberculin (T), viz. 64, 16, 4, and 1 per cent. Four scarifications were made with the Von Pirquet scarifier on the skin of the forearm and the dilutions applied, the weakest being nearest the hand so that a stronger dilution should not be carried up by the lymphatics to a proximal spot and vitiate the result. The resulting papules were measured, and also the difference in sizes were noted. By reference to a table of sensitiveness a figure was arrived at for each case. A clinical

significance was attached to those results which gave more than a certain numerical "sensitiveness value." Other methods using dilutions of T. and also P.T.O. (bovine), in strengths from 0·1 to 100 per cent., have been claimed as reliable by their authors.

It may be said, however, that no reliable differences between human and bovine tuberculosis can be elicited by these tests (Gauvain), and also that a really satisfactory quanti-cutaneous method for the diagnosis of active tuberculosis as opposed to latent tuberculous disease is yet to find. A negative result is of value. Von Pirquet concluded, as a result of his clinical and autopsy experience, that a positive cutaneous reaction in a child under two years old points to the existence of an active process, as latent foci are rare at that age. He recommends the test for the diagnosis of tuberculosis in early life.

The relation of the tuberculin reaction to the specific inflammation of animals immunized against foreign protein is not wholly clear. It is probable that the tuberculin reaction is referable to an antibody present in the tuberculous animal (Opie). In support of this several observers have claimed that animals may be rendered sensitive to tuberculin by injection of the serum of tuberculous animals, but others have failed to bring about this passive transfer of hypersusceptibility. Sera from patients tolerant to large doses of tuberculin possess the power of neutralizing tuberculin in certain dilutions.

As now performed, the test should be regarded as additional evidence to be taken with clinical signs, history, etc.

The following fallacies must be borne in mind:

(1) The reaction tends to disappear in advanced cases and in rapid miliary tuberculosis.

(2) It is absent in measles for the first ten days, and in certain other acute conditions.

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Some Pitfalls in Medical Diagnosis.

By SIR BRUCE BRUCE-PORTER, K.B.E., C.M.G., M.D.

PROBABLY three-fourths of the medical profession to-day are found in the ranks of the general practitioners, who are essentially the most important group. They see the patient as a whole. They are acquainted with his personality and surroundings, and should decide which specialist be called in to assist in the care of a difficult case. They must, in a measure, protect the patient from the real danger which may be threatened in some cases by the narrower view of the unsuitable specialist.

They should be the real diagnosticians, prepared and qualified to weigh the evidence and the opinions of various specialists. An error in diagnosis, therefore, on their part may prove a very serious matter for the patient, and their responsibility is correspondingly great. In the space allotted to me in this Special Number of The Practitioner I hope to point out the manner in which some of the more common mistakes in diagnosis are made.

Those of the younger members of the profession are

often due to the fact that their clinical experience has been acquired almost entirely in the wards of hospitals filled with rare or serious cases, patients in the later and more advanced stages of illness. They are, therefore, apt to look for rarer causes to explain symptoms rather than the simpler and more common ones, when they enter private practice and are consulted for early symptoms of common diseases.

The older men are apt, in the pressure of work, to give less time to consideration of a case than they should, trusting to snapshot diagnosis without proper and detailed examination of the patient. During the last twenty-five years in which I have been engaged in private practice, the cases wherein I have found errors in diagnosis have almost invariably been due to want of complete examination, and I propose to illustrate my remarks from cases to be found in my records.

The first examination of a patient should include his previous medical history and his mode of life, especially as to food and work. The physical examination should be as complete as possible.

Beginning with the teeth: If artificial dentures are being worn, they should be removed and the gums examined for stumps. I have repeatedly found a complete upper set hiding a large number of septic roots. In one case the patient was having vaccine administered for arthritis, and in another was taking iron for anæmia. Crowned or capped teeth or even those not obviously dead may have abscesses at the roots, and the X-rays may be the only way of discovering them; X-rays should be used much more frequently than is the case at present.

Some years ago a patient was brought to consult me. She had been sent to London to have lessons in Braille, as her sight was failing more rapidly than age would account for. She had been told that she was going blind. X-rays showed numerous infected roots, and when these were removed the retinitis due to sepsis cleared up, and her vision improved so that the lessons in Braille have never been required.

Digestive derangements are often due to failure to keep the bowel clear. Yet how frequently do we find that the abdomen has not been examined.

When a patient says that the bowel acts every day it may be true, but the colon may, nevertheless, be loaded. A simple test I use is to give a few charcoal lozenges after breakfast one morning, and ask for a report as to when the black colour appears in the motion, and for how long it continues. Often in patients who are satisfied that there has been a regular daily action I find the action is one or two days late.

"Growth" in the abdomen is not an uncommon diagnosis given to a patient who complains of discomfort and diarrhœa, in whom a lump is found on examination. Naturally other opinions are sought, and when a couple of enemata clear out the tumour, the family doctor's reputation may go with it. On the other hand, there may be irregular action of the bowel; malignant disease of the rectum is often overlooked till too late for removal, because the patient has not been examined per rectum. In these days of travel, and especially when so many served overseas during the great war, careful microscopical examination of stools from patients suffering from diarrhœa is important, as dysentery or intestinal parasites may be the cause of it.

Repeated bilious attacks in children due to inflammation of the appendix are too often allowed to pass on to abscess formation and death, because the diagnosis of "chill on the liver" has been taken as a serious one. All bilious attacks occurring at rather lengthy intervals in children should be investigated as possible appendicitis. The number of adults who to-day suffer from chronic indigestion as a result of appendicitis in childhood is legion.

Examination of the chest should never be made through the clothes. It is tragic to find a patient, who has been taking cough mixture for many months for

an irritating cough, has a bulging sternum due to an aortic aneurism. The common habit of pulling up the shirt does not give sufficient chest exposure, as in several cases within my knowledge where this has been done the seat of the trouble has been covered. In one case the isthmus of the thyroid was enlarged and pressing on the trachea, and in another a pulsating aneurism was to be seen in the second interspace.

Neglect to make use of X-rays in the examination of the chest in patients complaining of pain in that region has been the cause of failure to recognize several cases of aortic aneurism. When so simple a method of correct diagnosis exists, it is sad to know so many cases of this condition still await discovery in the post-mortem room. Examination of sputum should be the rule in every case of cough, no matter what the age of the patient; there is no age at which tubercle bacilli may not be found, and neglect to discover them in cases of active tubercle bacilli is serious, not only to the patient, but also to those living in contact with him.

Recently I saw a lady, 74 years of age, who was said to suffer from winter cough, and who assured me her temperature was normal, but whose sputum, I found, was teeming with tubercle bacilli: her temperature, it is true, was only just above normal at its highest, but the variation below normal was enough to show quite an irregular temperature when the chart was held upside down.

Failure to examine the urine may result in grave danger to the life of the patient and to the reputation of the doctor.

One of the most tragic cases I can call to mind was that of a lady who consulted me for noises in the head and double vision, which she thought rather amusing. She was 7½ months pregnant, and her medical attendant had not once examined her urine during her pregnancy. She could not understand why I wished a specimen sent me at once as she was sure there could be nothing wrong with her kidneys as "she was up frequently during the night passing urine." The urine became solid in the test tube on boiling. I passed her at once to her obstetricians, and in spite of everything they could do she died during labour which set in 24 hours later.

Another patient, a boy at one of our public schools (which

incidentally does not have a regular school medical officer), was brought to me by his mother because she was anxious about him. He was losing weight and avoided games. He had been given a severe talking to by the doctor and also a tonic. There was nothing in his physical condition to explain the reason for his loss in weight, but an examination of his urine showed he was suffering from diabetes, the urine being loaded with sugar, and acetone was present in considerable quantity.

When dealing with cases of frequency of micturition, it is well to examine the abdomen carefully, to exclude the possibility of overflow from a distended bladder, and even when no very definite increase in dullness can be made out it is wise to pass a catheter, especially in cases of locomotor ataxia. I have on more than one occasion found the bladder distended up to the level of the umbilicus in such cases.

Another class of case is the elderly woman with cystocele. Recently I met with a patient who complained of frequency, and whose residual urine was 16 ozs.

Enlarged prostate may cause overdistension even when the size of the gland, as felt per rectum, may not be very great.

Œdema of feet and ankles is another condition in which neglect to examine the legs from the feet to the groin may cause chagrin to the doctor. I will give three examples :—

The first was an officer from India, who was thought by some to have cardiac weakness, but examination up to the femoral ring revealed the cause. He had suffered from bubonic plague in Poona, and the bubos had been freely opened; the lymphatics were involved in the scar—the swelling was lymphatic.

The next case was that of a lady who had been treated in Germany for swelling of feet and ankles by being kept in bed for a month and given cardiac tonics. As she did not improve she decided to return to England. Examination of the abdomen revealed an impacted fibroid as the cause. Her heart was quite normal, and removal of the fibroid brought about recovery.

The third case is even more interesting. The patient, an active man of over 70 years, was in a state of considerable anxiety when he came to see me. He gave his own diagnosis as dropsy. There was swelling of both ankles, but the right was definitely the more swollen, and this suggested the possibility of an abdominal growth; but following my usual plan of tracing the swelling upwards, I found

that he was wearing a single truss with a very powerful spring. It had been fitted by an ordinary instrument maker, and the pressure of the pad on the femoral vein was the cause of the swelling. A properly fitted truss was sufficient treatment to cure the case.

Fainting attacks are almost always treated as due to cardiac weakness, whereas a few questions will often elicit the important point that the patient fainted when sitting in an easy chair or even when in bed, and that the fainting was an epileptic attack.

In patients from the tropics it is a mistake to treat everyone who has an attack of fever as though it were due to malaria, and to give quinine. I make it a rule to have a blood examination in every such case, and unless the parasite be found, or a marked increase in the mononuclear count be reported, I withhold quinine and seek some other cause for the fever. When a woman comes to consult a doctor for some seemingly trifling ailment, this is often merely an excuse to get the doctor's opinion; the real reason is some hidden fear of cancer, and she hopes a complete examination will be made and her fear dispelled. The breasts can be examined as if feeling the heart's impulse or chest expansion, and when found normal, she may be told there is no cause for anxiety on that head.

An inquiry into the habits, especially of feeding, will surprise many. The number of people who eat excess of meat and shortage of vegetables is amazing, and they even seem proud of their folly. They eat meat in excess because they like it, and they do not drink water because they claim that they are never thirsty. Unless faulty dietary be corrected they may swallow the contents of a chemist's shop without being in the least benefited. Especially is this the case in patients suffering from rheumatism and digestive disturbances.

Finally, another cause of error is accepting as correct a diagnosis brought by the patient without confirming it by independent examination, as these diagnoses are often made by lay friends.

The Difficulty of Accurate Diagnosis.

By SIR THOMAS MYLES, C.B., M.D., F.R.C.S.I.
Surgeon, Richmond Hospital, Dublin; Professor of Pathology, Royal College of Surgeons in Ireland, etc.

THE tendency of to-day, among lay folk and the members of the medical profession alike, is to speak and write somewhat boastfully of the great progress medicine and surgery have made in recent years. As a result of this development many people are under the impression that in both surgery and medicine everything, in the words of the immortal Pangloss, is for the best in the best of all possible worlds.

Undoubtedly treatment both medical and surgical has made giant strides in the last twenty years, but in spite of all the aids that modern science has placed at our disposition, I doubt very much if accuracy of diagnosis has kept pace with treatment. Once an accurate diagnosis is made, surgery and medicine can be relied upon to give the patient the very best and latest developments in the way of treatment.

But, in truth, is accurate diagnosis the rule or the exception? In all humility, and without wishing to exaggerate in any way, after more than forty years' experience of work in large hospitals I am inclined to believe that accuracy of diagnosis is less common than we are apt to imagine. Very little reflection will show that this must be so, and that it is unfair to attribute blame to those of us who are responsible for these mistakes in diagnosis.

Let us consider, for the present, some cases of injury, surgical cases of disease having already been discussed,

Every surgeon is exposed in the practice of his profession to the risk of finding himself in a Court of Justice charged with lack of skill or care because he failed to make a correct diagnosis in a case of extreme difficulty, or because the treatment was proved *afterwards* not to have been the most efficient or suitable for the attainment of the object aimed at. Every practitioner is subject to the danger of hearing his intelligence and skill belittled by opposing counsel who, having read up the subject the night before, gives free rein to his imagination, and untrammelled by any responsibility can dogmatize on questions regarding which medical men of ripe experience have doubts and hesitations.

Accuracy of diagnosis is, in my opinion, not only difficult, but impossible in many cases, and this difficulty or impossibility is inherent in the nature of the case itself. Let me give a few examples by way of illustration.

Case 1.—A man was brought into the Richmond Hospital with the following history: With three other men he had been working at a hand winch, which was discharging grain in sacks from a ship. On this winch was a control brake made by the simple expedient of winding a rope a couple of times around the drum. The end of this rope was held by the foreman, and when the bags of grain were in position over the waggon, by easing the tension of the rope they were lowered gently into the waggon. Unfortunately this rope got worn and frayed, and when the bags of grain, weighing about 300 lbs. or more, were at the highest point of elevation, the brake rope parted, and the bags falling rapidly imparted a tremendous velocity to the revolving handles of the winch, one of which struck one of the men a violent blow on the left side of the anterior abdominal wall, lifted him in the air and hurled him backwards some feet on to the deck. He was picked up in a state of collapse and brought to hospital. On admission, in addition to the symptoms of profound shock, he had a swelling in the abdominal wall about four inches in length, and two in width, a couple of inches above Poupart's ligament and parallel to it. When he had rallied, a further examination was made. He was found to be tympanitic, the whole abdomen tender, and the swelling had an impulse on coughing, though dull on light percussion. The swelling was diagnosed to be a traumatic ventral hernia and operation advised. This was undertaken some five hours after the injury, and to the astonishment of all present the swelling proved to be a large lipoma, lying behind the external oblique muscle, and on the internal oblique. Some processes extended through the latter

muscle and spread themselves out on the transversalis. When the tumour was completely removed, the incision was carried through the transversalis and a large subperitoneal hæmatoma was exposed. On opening the peritoneum, all within was found to be perfectly normal. The patient made an uneventful recovery.

Case 2.—A woman of about forty years of age was admitted to hospital in great pain with persistent vomiting. On examination a swelling was seen and felt in the right inguinal region. This swelling was dull on percussion, had no impulse on coughing, but was tender to the touch. It was irreducible. The abdomen was somewhat distended, her temperature subnormal, her pulse feeble, and her extremities cold. A diagnosis of strangulated inguinal hernia was made, and after some stimulating treatment she was brought to the theatre and operated on. Instead of a hernia, a fairly large encysted hydrocele of the canal of Nuck was exposed. Next day the explanation was forthcoming. It appears that the lady had taken more alcohol than was good for her, that her husband on returning from his work, angry at her condition and not finding his supper ready, took the law into his own hands and had given his unworthy spouse a severe beating. This she naturally concealed from us. The vomiting was probably due to the combined effects of the alcohol and the beating, the latter accounting also for local tenderness and tympany.

Case 3.—A stout woman of about fifty years of age was accidentally knocked down in the street by colliding with a horse and car. She was brought to hospital complaining of great pain in the left hip and left gluteal region. There was no shortening, no obvious deformity, but owing to her obesity and huge limbs, palpation of the injured area gave little information. After a few days all her symptoms seemed to have disappeared, but to make sure that we had not missed either a fracture or a dislocation she was put under ether and carefully examined by the entire surgical staff. The limb moved freely in every direction, no crepitus could be elicited and no shortening could be detected either when the legs were fully extended, or when the level of the knees was compared with the hip and knee joints both flexed to 90 degrees. This method of comparison will give useful information in cases of so-called sciatic dislocation of hip. The X-rays had not reached us at the time I speak of. Having satisfied ourselves that we had overlooked nothing in our examination, the patient was sent home a few days afterwards.

Some five months later a senior colleague who had been called to the lady brought me to see her. She had now an obvious dislocation on the dorsum ilii. The most plausible explanation of the mystery that occurs to me is that the lady had sustained a fracture of the rim of the acetabulum without displacement, that subsequently being encouraged by our collective assurance that she had neither a fracture nor a dislocation, she began to make use of the limb both too freely and too soon. As a result the fragment of the rim of the acetabulum had given way under her great weight,

and the head of the femur, no longer supported, had escaped on to the dorsum ilii.

It is sad to think that in this case, if we had not been rendered so confident by our prolonged and careful examination under an anæsthetic that she had sustained no serious injury, and had merely kept her in bed for three or four weeks, her hip would never have been deformed, and she would not have spent the latter days of her life under the mental and physical burthen of a lame and deformed hip.

Shoulder-joint injuries are peculiarly liable to errors in diagnosis. In all of these cases there are certain common symptoms: pain, great swelling, loss of power, local tenderness. Accurate measurements are impossible.

To the inexperienced it seems impossible for an intelligent man to fail to diagnose the existence of a dislocation or a fracture in proximity to the joint. To those of us who have seen these cases within the first twenty-four hours after the injury the failure is quite comprehensible. The great swelling, the intense pain, the inability or the unwillingness of the patient to submit to the necessary manipulation of the limb, the very natural aversion of the medical man to add anything to the patient's sufferings, coupled with the great bulk of the limb in fat people, render accurate diagnosis very difficult. An X-ray examination will, of course, clear up the diagnosis, but that method of examination is not always available, and the practitioner in charge of such cases is often severely and unjustly censured by people ignorant of their own ignorance.

The classical example of erroneous diagnosis is that in which the surgeon in opening what he believes to be an abscess in the popliteal space opens into an aneurism instead. The writer has had no such experience himself, but he once had a case of a parallel character.

Case 4.—A young man, very active and a great walker, called one

day, complaining of a painful swelling on the dorsum of his foot. A few days before he had taken a very long walk over the Wicklow Mountains, and when jumping down from a bank he felt a sudden pain in the foot. This did not last long and did not prevent his walking twelve or fifteen miles before he reached home. On the following day the pain was slight and he was able to attend to his business. The day before I saw him the swelling had increased in size and had become red and tender. He felt somewhat sick and out of sorts, but walked to his office as usual. The next day the swelling and pain increased and he came to see me.

On the dorsum of the foot over the anterior end of the scaphoid bone was a semi-spherical swelling, tense, not pulsating, very red and inflamed, and above it running up the leg was the red line of an inflamed lymph channel. The glands in the groin were tender. His temperature was slightly elevated, his tongue furred, and he said he felt rather sick. The swelling obviously contained fluid, and though fully aware of the possibility of its being a traumatic aneurism, I felt certain that I was dealing with an acute abscess. As a precaution, however, I got one of my colleagues to give the patient an anæsthetic and had ready the instruments necessary to deal with the graver possibility. An incision showed that we were dealing with an aneurism of the dorsal artery of the foot, a rare condition, I think, and the sac was dissected out and the artery tied above and below in the usual way.

The last case I shall record is a very remarkable one indeed.

Case 5.—A man about thirty-four years of age, an agricultural labourer, was walking on a country road when he felt something moist and warm running down his leg. Pulling up his pants he found a tiny trickle of blood, and tracing this up he found that it was issuing from what looked like a pin-hole puncture on the inside of the thigh exactly over the internal saphenous vein. Stripping down his clothes, he bound a handkerchief tightly around the limb and controlled the bleeding. A good Samaritan with a horse and cart was passing and gave him a lift into the small town some four miles away. There the doctor saw him and sent him up to hospital as a case of ruptured varicose vein. On admission to hospital bleeding had ceased and the man said he felt perfectly well and had no pain. The saphenous vein was varicose and in parts thrombosed. The little puncture hole was apparently closed by a clot. He was advised to have the veins operated on, and meanwhile to rest in bed until the day of operation. Next day on walking from his bed to the lavatory the bleeding recommenced, and an alert resident pupil noticed that the blood was very red, not at all like venous blood. He was at once brought into the operating theatre and before making any incision a probe was passed into the little puncture on the thigh. To my astonishment it passed in to a depth of several inches and struck bare bone. The withdrawal of the probe was followed by a sharp gush of arterial blood. This was controlled by local pressure and an Esmarch's bandage put around the thigh high up. The

probe was again introduced, and, using it as a guide, the tissues were dissected carefully until the popliteal space was opened fairly freely from the side. With my fingers I could now feel a small flat sequestrum with sharply serrated edges. It was mobile but lay under the artery and was removed with the utmost caution. There was no attempt at an involucrum and the sequestrum was evidently formed from the flat popliteal surface of the femur. With the knee joint flexed and the limb rotated outwards, the edges of the wound being retracted, it was now possible to see into the wound and recognize the vessels. Slackening of the Esmarch bandage showed that the blood was coming from the popliteal artery, near the adductor opening. As it was practically impossible to secure the vessel there, an incision was made higher up and the artery tied in Hunter's canal, the lower space being loosely packed with iodoform gauze.

This case must be almost unique. I used to hear, as a student, of "quiet or silent necrosis," but here was a sequestrum that must have taken months in forming and separating, and which was, unfortunately, so mobile that a sharp point of one of its spicules succeeded in penetrating the artery; yet the man had never lost a day's work, never complained of any pain, and attributed what inconvenience he had to the obvious varicose veins in his leg.

I think that I have produced sufficient evidence in support of my thesis that accurate diagnosis, even in surgical injuries, is very difficult and often impossible, and, as a deduction therefrom, that it behoves us all to remember our limitations, and when charges of ignorance or incompetence are brought against any of our profession to keep in mind the French proverb: "*Tout connaître, c'est tout comprendre; tout comprendre, c'est tout pardonner.*"

The Modern Diagnosis of Nervous Diseases.

By E. FARQUHAR BUZZARD, M.D., F.R.C.P.
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THE title of this article suggests an attempt to enumerate and describe any newly-discovered signs or recently-invented methods of investigation which have come of recent years to be utilized in the diagnosis of disease of the nervous system. While such additions to our clinical armament have undoubted value, and must necessarily claim some of our attention, the real advance in accuracy of diagnosis which has taken place during the last quarter of a century, depends mainly on a gradually spreading recognition of certain fundamental principles applicable to the whole of general medicine, and, for special reasons, to neurology in particular. Real progress has been and is being made, not through the agency of sudden and startling discoveries, but by a more peaceful revolution of slow development and sombre character.

At one time the diagnosis of many organic diseases of the nervous system was mainly dependent on the presence of so-called signs which could be elicited in the course of examining a patient. If such signs were present in sufficient number and in appropriate combination, it was justifiable to label the condition with a name. For instance, a patient with ataxic gait, absent knee jerks and Argyll-Robertson pupils, would be regarded as suffering from tabes dorsalis, and another with nystagmus, staccato articulation, intention tremor and exaggerated tendon jerks, as the victim of disseminated sclerosis. Nowadays, we do not wait until

these striking clinical features have become permanently established, but aim at making a diagnosis when the earliest evidences of disturbance of function make their appearance. A diagnosis of myopathy need not be delayed until the time arrives when the patient is only able to rise from the floor by climbing up his own legs.

Early diagnosis has, therefore, become more and more the monopoly of those who possess, in addition to a knowledge of the anatomy and physiology of the nervous system and of the morbid anatomy and natural history of nervous diseases, the ability to elicit from patients evidences of those slight disturbances of function which precede the signs and symptoms of structural defects. In other words, careful detailed history-taking is gradually being recognized as the first and most valuable asset in arriving at an accurate and early diagnosis.

It is impossible, therefore, to discuss modern methods of diagnosis without referring, in the first place, to the fundamental importance of detailed histories, the neglect of which is responsible for a large majority of diagnostic errors. The physical examination of a hemiplegic patient enables a doctor readily to conclude that there is some lesion of the pyramidal system in one or other cerebral hemisphere; the determination of the nature of that lesion, whether it be inflammatory, vascular, degenerative or neoplastic in origin, must depend largely on a careful analysis of the antecedents, of the mode of onset, and of the subsequent course of the morbid process.

The principles underlying diagnosis can perhaps be best illustrated by a consideration of a few of the more common organic diseases of the nervous system.

Disseminated Sclerosis.—Acquaintance with the natural history and morbid anatomy of this disease, although we still lack definite information in regard to its pathogenesis, teaches us that the central nervous

system is the site of patches of subacute inflammation which make their appearance singly or in crops. These patches or "plaques" may be distributed anywhere in the brain or spinal cord, with the result that the disturbances of function attendant upon them may assume the most various forms and may be mental, motor, sensory or reflex in character. It is characteristic, too, of these patches that they possess a natural tendency to repair, so that the disturbances of function almost invariably display a disposition to disappear either partially or completely.

The diagnosis of disseminated sclerosis does not, therefore, depend on finding such abnormalities of function as nystagmus, dysarthria, absent abdominal reflexes, and extensor plantar responses, but on obtaining a history of recurring disturbances of function affecting different parts of the nervous system and indicating multiple lesions, with a general tendency towards recovery after the shock produced by the appearance of each has passed off. The diagnosis of disseminated sclerosis can often be made from a history alone, not only in regard to patients with obvious signs of organic disease, but occasionally in others who have, by the time they come under observation, thrown off all clinical evidence of the disturbances from which they have suffered, and from which they have, temporarily at any rate, recovered.

Much has been written in the past on the bedside distinction between organic and hysterical disorders. It has been too little recognized that the history of a sudden localized failure of function, such as the use of a limb or the vision of an eye, followed by steady improvement and complete recovery in the course of a few weeks, with or without treatment, is very much more likely to be of organic than of hysterical origin.

Epidemic Encephalitis.—This is another disease produced by an acute or subacute inflammation of the

nervous tissues, differing from disseminated sclerosis chiefly in its more diffuse, less well-defined distribution, in its longer-drawn-out and less interrupted course, and in its more frequent association with general disturbances of health. It resembles disseminated sclerosis in that any function of the brain or spinal cord may be disturbed, and that, therefore, its diagnosis is not dependent on the presence or absence of any particular physical sign or symptom. Certain types of the disease are so common and characteristic that little difficulty attends their detection; but there are large numbers of cases which require very careful consideration and investigation before their true nature can be determined. Put quite briefly, the diagnosis of epidemic encephalitis depends on the recognition of an inflammation affecting larger or smaller areas of the brain, and the exclusion, as far as possible, of other inflammatory or toxic lesions such as those of meningitis, cerebral syphilis, uræmia, etc. The recognition of an inflammatory process is not always easy, but here again the detailed history of the onset and course of the disease is of the greatest assistance, and will often serve to exclude vascular, neoplastic or degenerative lesions. In addition, useful information may be obtained from skilled investigation of the cerebro-spinal fluid.

Subacute Combined Degeneration of the Spinal Cord.—A brief reference to this disease may be of interest in two directions. In the first place it affords a good example of one of the slowly progressive diseases of the central nervous system with insidious onset and characteristic developments. In the second place it illustrates the close association between morbid conditions of nervous tissues and those of the blood. According to Hurst, this affection of the spinal cord is constantly accompanied by achlorhydria, and, at some period in its development, by a blood picture resembling that of Sydenham's anæmia. The same observer

inclines to the view that the presence of hæmolytic streptococci in the duodenum, favoured by the absence of hydrochloric acid, may be responsible for the blood and spinal changes. From a practical point of view the diagnosis of subacute combined degeneration is thus facilitated by test-meals and blood investigations, and there is reason to hope that the earlier it is made the more successful may be the results of treatment.

The Cerebro-spinal Fluid.—The examination of this fluid is being utilized more and more in the diagnosis of diseases of the nervous system, and volumes could be, and have been, written on the subject. It is quite outside my scope here to do more than refer briefly to some of the more recent conclusions which have been reached, for the subject has been treated more fully in the following article by Dr. J. G. Greenfield. Examination of the fluid may be the decisive factor in establishing a diagnosis; for instance, in determining whether a patient, suffering from multiple lesions of the nervous system, is the victim of disseminated sclerosis or of cerebro-spinal syphilis. In the former disease the fluid is normal in about 50 per cent. of cases; in the remainder the following abnormalities may be detected:

(1) a slight increase in number of mononuclear cells;

(2) a normal amount of protein with slight increase of globulin content; and

(3) a paretic or luetic type of curve with the Lange reaction.

On the other hand, the fluid of a patient with cerebro-spinal syphilis who has not been treated, will probably show:

(1) a moderate or large increase in number of lymphocytes, in proportion to the degree of meningitis;

(2) a considerable rise in amount of protein and globulin;

(3) a strong curve of the luetic type with the Lange reaction; and

(4) a positive Wassermann reaction.

Reference has already been made to the difficulty occasionally arising in the diagnosis of epidemic encephalitis, and it cannot be said that examination of the spinal fluid in such cases is always decisive, but the following features are very suggestive of the disease:

(1) the fluid is under increased pressure and may be blood-tinged;

(2) a slight increase in cells, the majority of which are small lymphocytes, especially in the first few weeks after the onset of symptoms;

(3) a normal protein content even when there is considerable lymphocytosis;

(4) a moderate increase in glucose content; and

(5) a luetic curve with the Lange reaction in perhaps half the cases.

The help in diagnosis obtained from examination of the cerebro-spinal fluid has been recently increased by the introduction of what is known as "cisternal puncture." By this method the fluid from the cisterna magna can be withdrawn, examined and compared with that obtained by lumbar puncture. Useful information is thus available for the detection of obstructions in the subarachnoid space which prevent the fluid from circulating freely in the lower parts of the vertebral canal. When such obstruction exists the fluid collected from below displays special features known under the name of "Froin's syndrome." The characteristics of this fluid are:

(1) its yellow coloration;

(2) its excessive protein content; and

(3) a certain, but not constant, increase in the number of cells.

A valuable aid in the localization of these obstructions, and therefore in the exact localization of spinal tumours, has been acquired from Sicard's method of injecting lipoidol into the cisterna magna, followed by an X-ray examination of the spine. The lipoidol, being opaque to the rays, indicates, by the position to which it falls, the upper level of the block in the subarachnoid space. Similarly, the lower level of the obstruction can be determined by injecting lipoidol into the lumbar region, and photographing the patient in an inverted position.

The Psycho-neuroses.—It is not so many years ago that the diagnosis of a neurosis or of hysteria was mainly founded on the absence of physical signs of organic disease. Nowadays we are not so easily contented. Just as in the case of organic diseases, we seek for a cause, a psycho-pathology, responsible for the clinical picture presented to us, and again we are obliged to resort to a detailed history of all events and experiences which have preceded the onset of symptoms. This history-taking, whether it is labelled psycho-analysis or goes by any other name more sweet, is of paramount importance in arriving at a diagnosis, and unless it is successful in revealing an adequate mental disturbance, the label of anxiety neurosis, neurasthenia, or hysteria can rarely be justified.

It is difficult to emphasize too strongly the importance of realizing that "functional" as well as organic disorders of the nervous system demand an insight into their pathology before their diagnosis or treatment can even be considered.

The Value of Examination of Cerebro-Spinal Fluid.

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IN the examination of the cerebro-spinal fluid as an aid to diagnosis it is essential that there should be full co-operation between the clinician who performs the lumbar or cisternal puncture and the clinical pathologist who carries out the necessary tests on the fluid. Too often this is absent; the clinician draws off the fluid, notes its appearance by a hasty glance, and sends it to the laboratory either without a diagnosis, or if a diagnosis is given, with no history of the case. When things are done in this way the clinician misses certain observations which may be essential to diagnosis, such as the pressure, and the free pulsation of the fluid, or the slow formation of a coagulum, while the pathologist may use so much fluid in the performance of unnecessary tests that he has not enough for those tests on which the full diagnosis depends. It is, therefore, hardly remarkable that the pathological report frequently gives the clinician but little help in understanding the case.

In the first place it must be realized that there are many chronic diseases affecting the nervous system, and even a few of a more acute nature in which the cerebro-spinal fluid shows no noteworthy changes. In such cases lumbar puncture is performed with the hope, but not with the certainty, that it will help in the diagnosis. But in a large number of nervous diseases we may confidently expect to find changes which are to some extent characteristic, and which in many

cases will clinch the diagnosis.

In considering the types of case in which an examination of the cerebrc-spinal fluid may be of value, it is convenient to divide them into three classes, according to the urgency of lumbar puncture :—

Class 1.—Cases in which the fluid should be examined. In this class may be placed every case with symptoms of meningeal irritation, and also most cases of coma, even when its cause appears to be evident.

Class 2.—Cases in which the fluid is always altered in some respects, but in which the diagnosis may be sufficiently established without lumbar puncture. This class includes almost all acute and subacute cerebral and spinal affections in which symptoms have established themselves in the course of a few days or weeks.

Class 3.—Cases in which we may or may not get any information from the examination of the fluid. In this last group, which includes most of the more chronic nervous diseases, the chief value of lumbar puncture may be the exclusion of neurosyphilis, since in most other forms of chronic nervous disease the cerebro-spinal fluid shows little departure from the normal. But in a certain number of cases, those, for example, of cerebral and spinal tumour, it offers more positive evidence. Even though the chances of this are small, they sometimes warrant the inconvenience to the patient which lumbar puncture involves, in the hope that a more accurate diagnosis may lead to a more effectual treatment of his disability.

The next question to be settled in each case is whether lumbar or cisternal puncture should be performed. To some extent this depends on the skill of the operator, for those who find cisternal puncture as easy, or even easier, than lumbar puncture will naturally choose this route more often than those to whom it presents all the terrors of the unknown. In the majority

of diseases lumbar puncture will give as much, or even more, information than cisternal puncture and, as it is much the safer operation, it is usually preferable. When for any reason cisternal puncture appears to be essential, it should only be undertaken after a careful study of the technique from diagrams and descriptions, and after practice on the cadaver. It is a good general rule that cisternal puncture is unnecessary when the pressure and pulsation of the fluid obtained by lumbar puncture are normal, and when there is a free flow of fluid on tapping this region of the subarachnoid space. For these are indications that the communication and interchange between the lumbar fluid and that surrounding the base of the brain are free, so that by examining the former we get a fairly accurate knowledge of the condition of the latter. But when there is obstruction within the spinal canal the fluid in the lumbar canal becomes altogether different in composition from that above the level of the obstruction. This frequently occurs in subacute meningitis, especially meningococcal and staphylococcal meningitis, and in cases of spinal compression by tumour of the cord or its meninges or by disease of the vertebræ. Thus, in meningitic cases the cisternal fluid may be turbid or even purulent, and may contain many micro-organisms, while the lumbar fluid is clear, yellow, and sterile. Cisternal puncture will then be necessary in order to drain off the purulent fluid and, when possible, to inject anti-serum by this route or to wash out the spinal canal. In cases of spinal compression the cisternal fluid often remains normal while the lumbar fluid gives evidence of a spinal block. Here puncture of the cisterna magna is not so necessary, but it may be advisable both in order to examine the fluid in this region and to inject lipoidol for the localization of the upper limit of the obstruction.

The actual technique of lumbar puncture scarcely

falls within an article of this kind, but a few words as to armamentarium are necessary. Usually the pressure of the cerebro-spinal fluid is neglected, as an exact reading of this complicates the operation considerably, and makes it more tedious for the patient. But in many cases the observation of the pressure and pulsation of the fluid in a manometer, not only at the beginning of lumbar puncture but also frequently during the withdrawal of fluid, is valuable both for diagnosis and to safeguard the patient from the risks of too great or too sudden withdrawal of fluid. It is probably always safe to draw off fluid slowly until the pressure is reduced to three-fourths of the original reading. But in many cases of increased intracranial pressure (i.e. when the fluid pressure reaches or exceeds 20 c.m.) no reduction beyond this is advisable. A comparison of the reduction of pressure with the amount of fluid withdrawn may also give some indication as to whether the increase of pressure is due to cerebral tumour or to hydrocephalus or "serous meningitis," as the fall is much slower in the latter conditions. It must be remembered that the use of a manometer may increase the danger of meningeal infection unless the most careful aseptic precautions are taken.

Whether a manometer is employed or not the fluid must always be drawn off slowly, and, therefore, for diagnostic punctures a needle with a very fine bore should be employed. The tubes into which the fluid is received should be made of thick glass, and stoppered with rubber corks, or, still better, very small glass-stoppered bottles may be used. They should be clean and sterile, but they need not be absolutely dry. It is well to be provided with two or three such tubes or bottles, both because it is not wise to have all your eggs in one basket, and it is advisable to save all the fluid, even if the first few c.cms. are contaminated with blood, and at the same time to have at least two

or three c.cms. of clear fluid for some of the more delicate tests.

The amount of fluid needed for diagnostic purposes depends on the clinical condition. In cases of suspected meningitis, or of coma, at least 10 c.cm. will be needed for the necessary tests. This should always be collected into two tubes, one of which is sent to the laboratory without delay for culture and cell count, while the other is kept without shaking at room temperature for an hour or two in case a coagulum should form. Too often the presence of a coagulum is missed because the shaking which the fluid receives in transit from the bedside to the laboratory either prevents its formation or breaks it up if it has already formed. There is no more delicate test for fibrinogen than the formation of this coagulum, and its appearance is of great diagnostic value in many cases. This second sample of fluid can be forwarded to the laboratory later, in order to complete the chemical examination when the cell count has given the first indication of the nature of the disease.

In spinal conditions, on the other hand, not more than 6 c.cm. of fluid are usually necessary. The pathologist should receive along with the clinical history a note of the pressure of the fluid and of the presence or absence of coagulum.

Certain deductions can be drawn at once from the appearance of the fluid and from the presence of a coagulum. In cases presenting cerebral or meningeal symptoms a considerable blood contamination may mean either accidental injury to a vessel by the lumbar puncture needle, or pre-existing cerebral or subarachnoid hæmorrhage. In the first case the upper part of the fluid, when the corpuscles begin to settle, will be colourless, or almost so, whereas if the hæmorrhage has taken place an hour or more before lumbar puncture the upper fluid is always yellow, and may even be of an orange or tan colour. If the fluid is drawn into

several tubes all will show the same degree of blood contamination if the hæmorrhage had occurred before the operation, whereas the first will usually show more contamination than the others when the hæmorrhage is due to the puncture. But neither this observation nor the absence of a coagulum in pre-existing hæmorrhage is so trustworthy a guide as the colour of the upper fluid.

Cases of so-called "spontaneous" subarachnoid hæmorrhage present symptoms so similar to those of meningitis that they have often been called "hæmorrhagic meningitis"—a condition which is rarely found apart from anthrax. Sometimes the blood contamination has been thought to be accidental, and the pathologist has made no examination of the fluid other than culture, which has proved sterile. In cases of this kind the diagnosis can be made, almost with certainty, a few minutes after lumbar puncture, when it is noticed that the clear upper fluid is deeply tinged with yellow or tan.

Clear, colourless fluids forming a fine coagulum on standing are found in many early cases of meningitis, especially in tuberculous meningitis and the more severe syphilitic forms, and also in poliomyelitis and polio-encephalitis. Purulent fluids or a turbidity due to pus cells indicate meningitis or abscess, but give no indication as to the extent of the former, whether localized or generalized, or to the position of the latter, whether extradural or intracerebral. Turbidity due to slight blood admixture is often only to be distinguished from purulent turbidity after the cells have been allowed to settle.

Slight yellow coloration of a clear fluid indicates in cerebral cases either tumour or thrombosis or old-standing hæmorrhage. Occasionally even the first puncture of a case of meningitis gives a clear, yellow fluid, showing that spinal block has already occurred, but along with this yellow coloration there is a much greater increase in protein than occurs in cerebral tumour or thrombosis.

In cases of spastic paraplegia the withdrawal at a

low pressure of fluid which is yellow in colour and which coagulates spontaneously is strong evidence of spinal subarachnoid block. This yellow colour or "xanthochromia" along with "massive coagulation" of the fluid has been called "Froin's syndrome," and was first described by him in cases of syphilitic meningomyelitis, but has also and, perhaps, more frequently been observed in cases of spinal tumour. That it is not always, however, an indication of tumour is proved by its presence not only in syphilitic myelitis, but also in acute transverse myelitis, and in many forms of vertebral disease, such as acute or subacute osteitis, Pott's disease, and aneurysm of the descending aorta. It may occur also in some forms of acute polyneuritis, associated then, of course, with paraplegia of the flaccid type.

It is impracticable for the clinician to estimate quantitatively the amount of protein present in the cerebrospinal fluid, but he may easily find out whether there is any pathological increase by boiling half an inch of the fluid in a small tube (4 by ½ inch). For globulin the Pandy test is the most convenient, as it consists simply of allowing one drop of cerebro-spinal fluid to fall into half an inch of 1 in 15 carbolic acid. The best reagent for the purpose is a saturated solution of carbolic acid in distilled water, made by shaking up liquefied phenol in the water until no more dissolves, and allowing to settle; but colourless 1 in 20 carbolic acid solution acts quite well. Both with this test and on boiling the fluid there should normally be only a very slight opalescence.

Before leaving the question of what a bedside examination of the fluid can tell us, it may be well to refer to one examination which the clinician should make in cases of suspected meningitis, namely, the examination of the fluid for sugar. For this test 20 drops of the fluid should be boiled with 5 drops of

Fehling's solution, when normally a heavy red precipitate is given. It is specially important that this examination should be made at the bedside in every case where meningitis is being treated by anti-serum, because an aggravation of the meningeal symptoms and increased turbidity of the fluid drawn off may be due, not to recrudescence of the disease, but to anaphylaxis to the serum used. If this is so, the fluid, although purulent, will contain abundant glucose, whereas if it is a true relapse glucose will either be absent or greatly diminished in amount. It is, therefore, unwise to inject serum in such cases if glucose is present in normal amounts.

The further examination of the fluid must be carried out in the laboratory, but it is well that the clinician should know which tests are of especial value in each case, and which are useless; otherwise he incurs the expense of having tests performed which will be of little help to him in diagnosis. In the first place a sharp distinction must be drawn between cerebral and spinal cases as regards the tests which are needed. In acute cerebral cases, that is to say, in cases of suspected meningitis, coma, or fits, the quantitative estimation of chlorides, glucose, and urea is important, whereas these examinations are useless in cases of paraplegia. The chlorides always retain a level of 0·72 per cent. to 0·75 per cent., except in meningitis, when they are reduced, and in uræmia, when they are increased. A drop in the chlorides to below 0·68 per cent. is the most valuable indication we possess of the presence of generalized meningitis. So long as meningitis is localized to the region of a cerebral abscess or to a zone of extradural inflammation the chlorides remain approximately normal, and when this is so, even though the cerebro-spinal fluid be turbid with pus cells and contain bacteria, we need not despair of saving the patient.

The examination for glucose is valuable, because in

many diseases associated with an increase of intra-cranial pressure the spinal fluid glucose rises to the neighbourhood of 0·1 per cent., whereas in meningitis it falls very rapidly from the normal 0·05 per cent. to zero. Percentages of glucose much above 0·1 per cent. are rarely found apart from hyperglycæmia and uræmia, in which they are the rule. A urea estimation is called for when there is the slightest reason to suspect uræmia. It replaces an estimation of the blood urea because the percentage of urea is always similar, if not identical, in blood and cerebro-spinal fluid.

Another test which has special value in cases of suspected meningitis is the Weil-Kafka reaction for hæmolysin and complement. This test often gives positive results in the very earliest stages of meningitis when an increase of cells is the only noteworthy change in the fluid. Complement is so constantly present when meningitis is more fully established that it is scarcely worth while to examine for it, but in the earlier stages of tuberculous meningitis the test is of real value.

As regards the other examinations which must be made, there is less distinction between cerebral and spinal cases. The cytology always holds the first place in diagnosis, and, therefore, a total and differential cell count should always be made by means of a counting chamber. It is important that this should be done within a few hours after the fluid is drawn off, as abnormal cell elements such as polymorphonuclears and plasma cells tend to break up and disappear fairly rapidly from the fluid. When there is considerable cell excess films of the centrifugalized deposit should be made and stained for tubercle bacilli and other organisms. Culture should be done whenever there is reason to suspect meningitis, and also with every turbid fluid.

An examination of the protein also should always be

made. If this has been done at the bedside by boiling the fluid, and by Pandy's test, and has proved negative, there is no need to do more in the laboratory, but whenever there is protein excess a quantitative protein estimation should be performed. This is particularly valuable when the fluid is clear and yellow, because xanthochromia, due merely to pre-existing subarachnoid hæmorrhage, is very rarely associated with more than 0·1 per cent. protein, whereas in cases of cerebral or spinal tumour, in polyneuritis, and in spinal subarachnoid block, there is rarely any yellow colour unless a considerably greater quantity of protein is present. Percentages of protein greater than 0·5 per cent. indicate spinal subarachnoid block, and are never found apart from this condition except in rare cases of tumour involving the cauda equina, or of polyneuritis affecting the sciatic nerves.

The Wassermann reaction of the fluid is important in any case of suspected neurosyphilis, as it may be positive even in cases which show no increase of cells or protein. This is particularly true of tabes dorsalis and inherited syphilis. Nor should the possibility of acute meningeal syphilis be forgotten in cases of meningitis of unknown nature. These cases of syphilitic meningitis are most common during the secondary stage of the disease, and sometimes are so acute as to resemble closely the meningococcal form.

The colloidal reactions have lately taken a prominent position in the examination of the cerebrospinal fluid, a position which is scarcely justified by their diagnostic importance. They are rarely necessary in acute cerebral conditions, except, perhaps, to corroborate the results of the other tests, but they may give positive reactions of varying strength in encephalitis lethargica and polioencephalitis. They are not, however, to be relied on in the differential diagnosis of these conditions from cerebral or epidural

abscess, or from early meningitis. In cerebral syphilis they add little to the diagnosis when the Wassermann reaction has been performed, and without this they are misleading. Perhaps their chief value is in the acuter stages of disseminated sclerosis, as in this disease strong colloidal reactions are frequently encountered in the absence of any notable increase of protein. In inherited neurosyphilis also, the colloidal reactions may be positive when the Wassermann reaction is negative. The kind of colloidal reaction to be performed should be left to the pathologist, as it is best that he should employ that to which he is most accustomed. The Lange, or colloidal gold reaction, is the most delicate, but the benzoin reaction and Kafka's paraffin reaction also give trustworthy results. The gamboge reaction appears to be rather less sensitive than these.

In cases of paraplegia, therefore, the only examinations which need be performed are those for cell and protein increase, along with the Wassermann reaction and a colloidal reaction. But even these four tests give most valuable help in the differential diagnosis of the various forms of paraplegia. Thus, syphilitic cases are at once recognized by cell and protein increase, and by positive Wassermann and colloidal reactions; disseminated sclerosis is indicated with almost equal certainty when a strong colloidal reaction is given by a fluid in which the Wassermann reaction is negative, and we may suspect this disease even when the colloidal reactions are weak or negative if there is an isolated lymphocyte increase of 20 to 50 per c.mm. The opposite condition of the fluid, isolated protein excess, especially when the protein is over 0·1 per cent., speaks for some more mechanical lesion of the cord, such as compression by tumour, and many such cases have been cured by timely operation based on the results of lumbar puncture.

Direct Endoscopy of the Lower Air Passages and Upper Food Tracts in Diagnosis.

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ALTHOUGH Mikulicz demonstrated forty-five years ago the practicability of examining the gullet by direct vision through straight endoscopic tubes of half an inch diameter inserted through the mouth, and Kirstein and Killian successfully applied the same method to the larynx and to the bronchi respectively at the end of the last century, it was employed merely by a few experts in the early years of the present century, and has only during the last fifteen years gradually been adopted as a recognized and indispensable routine measure in diagnosis and treatment in the areas included in the heading to this article.

THE LARYNX.

The larynx can usually be more easily and efficiently inspected indirectly for diagnostic purposes by means of reflected light impinging on the throat mirror, but there are some cases where lesions of the mucosa of the subglottic region can only be thoroughly investigated by the per-oral passage of endoscopic tubes. Although the endoscopic method has only a restricted use in diagnosis it has a very wide application in intralaryngeal treatment, more especially in the removal

of benign growths and foreign bodies and in the excision of a small portion of a suspected malignant growth for microscopic confirmation.

THE LOWER PHARYNX.

In the deep pharynx, namely, that portion of the third division of the pharynx which lies behind the arytenoids and cricoid plate, only a very restricted view limited for the most part to the pyriform fossæ can be obtained by the throat mirror; to make an efficient examination for diagnostic purposes the use of a direct vision proximally or distally illuminated tube spatula, preferably with a lateral slot, is essential. By means of my direct vision laryngo-pharyngoscope, or by Haslinger's instrument, one can prove the presence of foreign bodies, benign neoplasms, such as multiple polypi and small unsuspected malignant ulcerating lesions at the back of the cricoid or in the depths of the hyoid fossæ. By endoscopy, moreover, a dilated condition of the deep pharynx

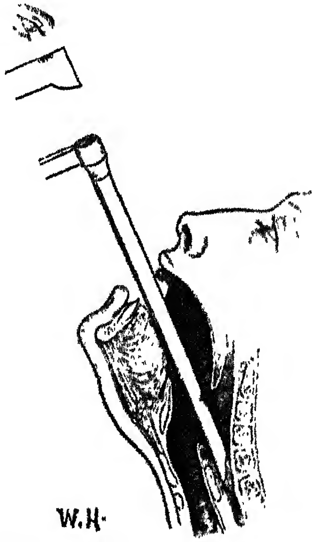

FIG. 1. Author's diagram to show the passage of a short œsophagoscopic tube behind the cricoid through the deep pharynx under local anæsthesia in the sitting position. Only the hood of Brünings' handle-lamp is depicted.

can be made out and the orifice of a pharyngeal pouch in the posterior wall seen. In cicatricial strictures, more especially those escharotic lesions which follow the swallowing of corrosive fluids, the upper orifice of the strictured area is often unsymmetrically placed, and only the endoscope enables this to be located and subsequently dilated up by graduated per-endoscopic bougieing.

THE ŒSOPHAGUS.

Although much information can sometimes be obtained by X-ray examinations in conjunction with barium or bismuth paste as regards the presence and location of foreign bodies in the gullet, and also of strictures of various kinds, it is important to remember in reference to the latter that even positive X-ray findings have no invariable differential value in deciding whether the stricture is malignant or benign and whether organic or functional.

These questions can only be satisfactorily determined in most instances by direct vision inspection, by means of endoscopic tubes. I have found that both diagnosis and treatment are greatly facilitated by employing tubes of larger calibre than those usually employed. My tubes are 18 and 20 mm. in diameter.

Most serious endoscopic work in the gullet in this country is carried out under general anæsthesia, which enables the investigation to be made at leisure with thoroughness, and there is the advantage that proper treatment can be proceeded with forthwith, e.g. the removal of a foreign body, the dilating up of a stricture, whether benign or malignant, by graduated bougieing, the performance of intubation or the insertion of a radium apparatus in malignant strictures. In cases where there is a doubt as to the stricture being malignant or not, a portion can be removed for microscopical examination—though in most instances

cancerous annular strictures are easily diagnosed by the irregular nodular upper end of the stricture as seen endoscopically, and by the presence of ulceration and sometimes of fungation; when there is no ulceration the fact that bleeding is easily brought about by slight instrumental manipulation is suggestive of malignancy.

In benign strictures bougies can be passed endoscopically, and organic strictures differentiated from functional ones, in which latter the potential lumen is normal. Through the œsophagoscope we are also enabled to ascertain with accuracy, not merely the distance down the œsophagus of the stricture, but the longitudinal limits of the stricture: a very important matter when treating a stricture by intubation or by radium or by diathermic destruction.

Benign growths are extremely rare in the gullet. I have, however, encountered two instances of polypi, and it is, of course, only by means of the œsophagoscope that such cases can be accurately diagnosed and successfully removed.

Although the use of the œsophagoscope has been largely written up round the subject of foreign body extractions, it must not be forgotten that foreign body cases form only a moderate proportion of patients with gullet lesions, and that per-endoscopic inspection and treatment is almost a necessity in nearly every form of gullet lesion if efficiency is aimed at.

THE TRACHEA AND BRONCHI.

Since Killian, so far back as 1899, first removed a foreign body from a bronchus with the aid of a proximally illuminated bronchoscopic apparatus, the endoscope has been extensively employed all over the world with more or less success for the extraction of foreign bodies from the trachea and lower air passages. In a fair proportion of cases the removal is comparatively easy even in moderately expert hands, but in other instances

the resource of even a very experienced endoscopist may be taxed to the utmost; and in some cases where foreign bodies are deeply embedded failure appears to be inevitable. Both skill and rapidity of work are of paramount importance; too prolonged manipulations have often led to fatal complications. Endoscopic methods have also been successfully employed for the removal of small polypi and other benign growths in the trachea and main bronchi; even portions of malignant neoplasms can be removed with temporary

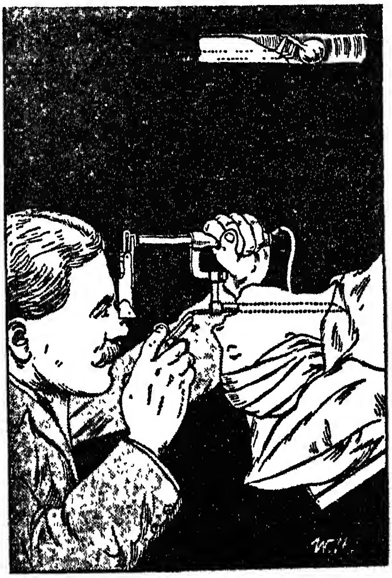

FIG. 2. Removal of a tracheal polypus in a child of seven years, under chloroform, by the aid of Brünings' handle-lamp, through a tracheoscopic tube, with Horne's forceps on Krause's handle. The inset shows the polypus, the pedicle of which is about to be seized by the jaws of the forceps. (Diagram drawn by the author.)

advantage where a main bronchus is nearly blocked. A bronchiectatic cavity can be localized and topically treated and its stenosed entrance dilated up and even intubated.

In the trachea not only have benign tumours been discovered to be the cause of a hitherto obscure stenosis,

but the endoscope enables us to exclude suspected neoplasms and to recognize the narrowing of the trachea—the scabbard trachea—due to external pressure from thyroidal and other tumours in the neck or as the sequelæ of injuries. More rarely the endoscope has been the means of demonstrating the presence of deposits of crusts and of ulcerations in the trachea or bronchi or both.

Killian has laid it down that per-oral bronchoscopy should be avoided in children under four years of age on account of the liability to œdema of the larynx if the examination is prolonged, and that it is safer to pass the bronchoscope in such cases through a temporary tracheotomic incision. I have, however, successfully removed, *per vias naturales,* a foreign body from a left secondary bronchus in an infant of thirteen months, and it was not found necessary to do an intubation afterwards; but in the case of a child of three years subsequent intubation did become necessary for two days.

GASTROSCOPY.

The stomach has been repeatedly proved to be well within the limits of per-oral endoscopic examination, both by direct vision open tubes and also by an indirect vision lens system periscope on the lines of the cystoscope. The findings, however, by such methods are obviously inferior to the more exact tactile examination and inspection following an exploratory laparo-gastrotomy.

Enough has been written to indicate to the practitioner the possibilities of per-oral endoscopic methods in a series of conditions in which an accurate diagnosis cannot be accomplished with absolute certainty by any other diagnostic procedure.

Modern Methods in Radiography in the Renal Tract.

By ROBERT KNOX, M.D.

Director of Electrical and Radiotherapy Dept., The Cancer Hospital (Free); Consulting Radiologist, Royal Northern Hospital and Chelsea Hospital for Women; Late Honorary Radiologist to King's College Hospital.

THE complete examination of the renal tract involves the employment of several special developments in technique. Of these the practitioner need not know the details, but he should be aware of the possibilities of a complete examination in the way of diagnosis, and particularly should know in what types of case of obscure abdominal disease the examination of the renal tract gives useful information.

The first practical point in all examinations of this tract is the thorough preparation of the patient, for upon it may depend the accuracy of the interpretation of shadows seen in this region of the abdomen. Purgatives are not desirable, but a complete evacuation of the bowels should take place at least two days before the examination. Any reliable laxative, which is known to suit the patient, is sufficient. Confection of senna is a reliable aperient in most cases. Enemata may be necessary, but they should be given carefully, in order to avoid any great gas distention of the colon. An enema is especially indicated when instrumentation of the bladder and ureters is contemplated.

The special developments of technique to be described are more or less in general use in urological practice, and it is imperative that complete collaboration should exist between the radiologist and the

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The special developments of technique to be described are more or less in general use in urological practice, and it is imperative that complete collaboration should exist between the radiologist and the

urologist, if the best value is to be obtained from the examination. In all urological examinations a survey of the whole tract may be made by (1) screen method, and (2) radiography. The former is not employed as a routine, though it may be useful for the detection of stones in the kidneys or ureters; the extent and direction of the movement with respiration, and movable kidney, if the excursion is considerable, may profitably be examined by the screen method, and if an opaque meal has been given the screen may be employed to determine the relation of several of the hollow viscera to the kidney and gall bladder.

Apart from these conditions the radiographic method gives more reliable information than the screen, and if a sufficient number of negatives are made in several positions, and in full expiration and inspiration, practically all of the information given by the screen method is shown on the negatives, while, in addition, for the detection of very small shadows and those of a low density, the radiographic method is far more reliable.

In recent years the ordinary routine examination of the renal tract has improved, in so far that when a stone is shown to be present in the region of the kidney or ureter, it is possible by the special methods to demonstrate approximately its position in relation to the kidney. Of these methods the following are given in order of value so far as accuracy is concerned.

PYELOGRAPHY.

Radiograms are taken in several positions of the patient, (1) antero-posterior, (2) postero-anterior, and (3) lateral. All of these positions will have been used in the preliminary examination, and a fairly good idea of the position of the shadow formed, but when the renal pelvis and the ureter are injected with opaque material through an opaque catheter, confirmation will be given

to the previous provisional diagnosis.

PNEUMO-PERITONEUM.

The injection of gas into the peritoneal cavity will, when radiographs are taken, show the position of the kidney and supra-renal body, and if a stone is present it will be more clearly shown; but the method is not free from danger, and is somewhat unpleasant to the patient, so that except in unusually difficult cases it is not advisable to suggest it. The same objection applies to the method of peri-renal inflation.

PERI-RENAL INJECTION.

The peri-renal injection method of Carelli, when carefully carried out, is useful, especially in doubtful cases of tumour involving the kidney and supra-renal body, and has for its chief advantage the beautiful contrasting pictures which are obtained, in which the outline of the kidney and supra-renal body are seen very clearly. It is probable that with improved technique all that is shown by these two methods will be seen in the pictures obtained by the ordinary technique. Indeed, no picture of the renal region is correct unless the outline of the kidney is shown clearly; in very high-class negatives the supra-renal body is sometimes seen by the ordinary method. A general improvement of the standard now obtained would go a long way towards making these methods unnecessary save in exceptional cases.

The technique of pyelography is simple so long as an expert does the necessary instrumental work. The material used generally is a 20 per cent. solution of sodium bromide. Great care is required in the passage of the opaque catheter, and some of the success of the investigation depends upon the position of the end of the catheter when the actual injection is made; if it has passed up into the upper calyx the probability is that only that structure will show fluid, because as it becomes distended pain is felt, and the injection is not

carried far enough to fill the pelvis. The time for which the fluid can remain in the pelvis without causing pain is also important. When several negatives of the injected renal pelvis are required, it is essential that the exposure should be as short as possible, and the changing of the films should be done as expeditiously as possible. For this class of work the radiologist and the urologist should be thoroughly conversant with the technique of each, so that as little time as possible is wasted in carrying out the steps of the technique.

It is suggested that in all examinations of the renal tract or the gall-bladder region lateral radiograms should be obtained, since these are extremely valuable in differential diagnosis. A practical point of some importance in this position is that the radiogram should be taken with the patient in the same position as when the antero-posterior picture was made. This necessitates the use of a lateral position of the tube and film-holder, a detail of technique which can be arranged readily. The reason for this suggestion is that if the patient is moved into the lateral position for the exposure, organs change their position, and the localization of the shadow is not likely to be an accurate one.

STEREOSCOPY.

It is freely admitted that if extreme accuracy in technique is possible this method will give very accurate results. Given the entire absence of movement during the time taken for the changing of the films and the exposure of the two, it will be possible to estimate the depth of a shadow from the skin surface of the patient. Similarly, if the kidney outline is sharply defined and free from movement it is possible to determine the position of the shadow relative to the renal pelvis and calices, but in the majority of cases, unless the technique is particularly rapid, movement invariably occurs during the time taken for the exposures,

and the slightest change in position of the kidney or stone will make the examination useless from the point of view of localization. It is urged, therefore, that for routine work the radiography of the kidney in three positions will give much more reliable information than the stereoscopic method.

In all attempts at localization in this region a thorough knowledge of the topography of the organs is essential. Above all, the normal position of the kidney in relation to the lumbar spine and the last two ribs must be kept in mind in all efforts to locate the position of a shadow.

In the examination of the bladder and the lower third of the ureter the usual antero-posterior position is most useful, and here it is possible to use the stereoscopic method to the best advantage, because of the lesser liability of movement of the parts. Stereoscopic pictures taken with an opaque catheter in the ureters will help greatly in the localization of the position of a doubtful shadow in the lower end of the ureter. In the bladder a useful method is to take a postero-anterior skiagram, when, if the stone is free in the bladder, a change in the position from that seen in the skiagram taken antero-posteriorly will show clearly that it is situated in the organ and not outside.

CYSTOGRAPHY.

This recent development in technique is specially applicable to such a condition as diverticula of the bladder. Sodium bromide or lipiodol may be used. For the determination of deformities of the male urethra the latter compound is useful when injected into the urethra and bladder.

DIFFERENTIAL DIAGNOSIS.

The chief value of the radiographic method lies in the possibility of differentiating: (1) the position of

the stone in the kidney, ureters, or bladder; (2) the nature of the stone from its X-ray appearances—oxalate calculi being the most dense of all, phosphatic calculi coming next, and uric acid calculi last. Calculi composed purely of uric acid occur rarely; generally there is an admixture of other and denser salts which make it easier to show the presence of such a stone.

The stone in the kidney is generally uniformly opaque, indeed it used to be thought that the shadow was homogeneous, but this is not invariably so. Gall-stones, on the other hand, are much less opaque, and it is frequently possible to show some detail in the structure of the calculus, a most important point in differential diagnosis. Size and shape of the shadow or shadows offer some indication of the nature and the position of the stones. Numbers are not so indicative, since either organ may contain from one up to several hundreds of stones. It is, therefore, customary to define two groups in both organs: (*a*) the single stone, and (*b*) the multiple. The most valuable differential point is the position of the shadow in relation to the spine and ribs in the antero-posterior and lateral positions. In a normal kidney normally situated the lateral radiogram shows the kidney situated behind the anterior border of the upper lumbar vertebræ. This holds good for most kidneys when involved in disease or containing calculi, so long as they are not enlarged or unduly mobile. Gall-stones in an enlarged gall bladder, on the other hand, are situated well in front of the anterior border of the lumbar vertebræ in the lateral position. The nearest approximation to that of a kidney stone would be a gall-stone situated in the common duct; this, in the lateral position, might be quite close to the anterior border, but it would never be behind that level. The only occasion on which a gall-stone would appear to be superimposed on the

stone shadow in the lateral position would be one situated in one or other of the hepatic ducts within the liver, a relatively rare occurrence.

In doubtful cases pyelography with lateral radiography will be helpful in clearing up the difficulty in diagnosis. Tumours of the kidney generally cause enlargement of the organ; this will lead to displacement, and should a calculus be present, it will share in the general displacement. In the diagnosis of tumours pyelography will show in a number of cases a deformity in some part of the pelvis or calices.

Hydronephrosis of the kidney will be readily demonstrated in all its stages if pyelography is employed. Horseshoe kidney is another condition in which the diagnosis is aided when modern methods are employed. Mobile kidney can, as a rule, be shown when good-class negatives are obtained, but in difficult cases a pyelography will show beyond any question the true position of the kidney and its injected pelvis.

One of the most difficult points in urinary diagnosis is to determine the position of a shadow occurring in the line of the ureter.

Frequently, in the pelvis, radiogram shadows are met with in the line of the ureter. These may be due to the presence of phleboliths, calcareous glands, or small calculi in the ureter. Each possesses characteristic appearances which serve to distinguish them, such as size, shape, position, consistence, and direction of the shadow. The most reliable method of distinguishing them is to insert an opaque catheter into the ureter and then take a skiagram. Should the catheter fail to pass an obstruction the diagnosis is clear, but when it passes the shadow the difficulty in diagnosis is increased. Stereoscopic skiagrams will be useful, for when viewed stereoscopically the relation of the shadow to the opaque catheter is seen clearly.

The Value of X-Rays in the Diagnosis of Diseases of the Lungs and Pleura.

By DAVID LAWSON, M.A., M.D., F.R.S.E.
Medical Director of Nordrach-on-Dee and Tornu Dee Sanatoria.

THE enthusiast who proclaims the general pre-eminence of X-rays as the one reliable means of diagnosing pathological conditions of the lungs and pleura, and belittles the employment of other well-tried clinical methods, seeking thereby to replace them by his own specialty, does the profession a signal disservice. The former can never effectively displace clinical methods. Its rightful position in the armamentarium of the physician is that of complement to those older methods; and as such it plays an important rôle. Rightly used in this way the help which X-rays may render is invaluable. In confining himself to the inspection and study of an X-ray plate supplied by the Röntgen specialist, along with the operator's interpretation put upon the appearance prescribed by the skiagram, he deprives himself of valuable data in enabling him to solve the difficulty of diagnosis, which ought to be at his disposal.

To get the maximum help the physician and the skiagrapher should always, where possible, collaborate, and examine the patient together by means of the fluorescent screen in the dark room. Ten or fifteen years ago this could quite well be dispensed with, when X-rays were to ordinary practitioners little more than an occult science, and quite beyond their ken. But with the improvement in the curriculum, and the facilities which are now provided for students making them-

selves acquainted with the principles and practice of X-ray work, all this is changed; so that the contribution which the physician may now bring in the X-ray room to the solution of difficult problems is hardly, if at all, inferior to that which the X-ray specialist supplies.

Some of the latter, I understand, claim to be able to distinguish by radiography alone the difference between an early acute lesion and one which is largely quiescent. A practical experience of well on to twenty-five years in X-ray photography does not permit me to concede this claim. Even after this lapse of time I should be sorry to abandon the teachers of my student days, who instructed me to seek proof of acute disease in the toxic symptoms which it sets up, and the clinical evidence of the rapid advance of the disease in the lungs as ascertained by auscultation and percussion, confirmed—if one likes—by screening or skiagraphy from time to time. This view has been recently strongly advanced by Dr. J. M. Johnston, and with it I cordially agree.

Skiagraphy alone, although it provides us with a permanent record, and may reveal changes invisible by the screen, is singularly incomplete; for there are certain important phenomena, of value to the physician, which it cannot disclose, and which, nevertheless, may easily be detected by screen examination. What, it may be asked, are those phenomena? And on what physical conditions do they rest?

The answer to the latter part of the question is to be found in the fact that the lung is a *tidal* organ. Its physical condition changes with the movements of respiration. And, further, the neighbouring organ—the heart—is a *mobile* organ. Never from the cradle to the grave does it rest its ceaseless activity. These fundamental facts are of the nature of a closed book to the photographer. He cannot make use of them. Not so

he who screens his patient. The trans-illumination of the lung, which increases during inspiration, and decreases during expiration, is clearly discernible on the screen. This is diminished in the area of an early lesion, and is a point of no small value in diagnosis in such cases.

Or again, take the piston movements of the diaphragm. The fact that the dome of the right diaphragm [illegible] at a level higher than that on the left side, and that the amplitude of the movement during respiration exceeds that on the other side, is familiar.

When the screen reveals an obvious limitation of this movement on the right side, thus showing the range of movement to be the same on both sides, the examiner notes the point as one of value in corroboration of a suspicion previously aroused as to the presence of a right apical lesion. Or he may find the level so high as to lead him to suspect either the presence of fluid in the pleural sac resting upon the diaphragm, or a greatly thickened basal pleura.

Movements of fluid in the chest are very easily discernible on the screen. Particularly is this so in cases of hydro- or pyo-pneumothorax. In those cases the movements may be of three varieties :—

1. Vertical movement with the diaphragm. These are only slight if a large quantity of fluid be present.

2. (a) Lateral wavy movements, transmitted by and synchronous with the beating of the heart, observable along the upper surface and line of the fluid.

(b) Irregular wavy movements, produced in the same area by the patient's coughs or jolts of his body.

3. Impaired movement of the ribs over the affected area during respiration—Nature's effort to provide rest to the affected part.

One may be tolerably certain before entering the X-ray room of the presence of fluid in the pleural sac

and still be in doubt as to whether the case is one of fluid only (fluid pleurisy or empyema), or whether there is also present in the sac air or gas, hydro- or pyo-pneumothorax. Let us take it that the physician wishes to avoid the use of an exploratory syringe, fearing to infect the fluid, should it happily be sterile, from the lung or through the chest wall. The recognition of the above movements places all doubt at rest.

There are the further two points of value in the differential diagnosis of those two conditions, which may be recognized also on the skiagram. With the patient in a sitting posture the line of the shadow may be clean cut and sharply defined, and meet the spine at a right angle. The patient's body should then be inclined laterally away from the upright position. In this new position it may be found that the level of the fluid remains horizontal, and, therefore, no longer forms with the line of the spinal column a right angle.

Beyond all shadow of doubt, in that case the chest contains air or gas *plus* fluid, and the case is one of hydro- or pyo-pneumothorax. On the other hand, it may be found that the upper border of the fluid is neither horizontal nor clean cut, but merges gradually upwards with ever-lessening depth of shadow until one is unable to determine at what point the fluid ends, and, further, that lateral movement of the body fails to affect this. In such a case one may confidently exclude the presence of air. The appearance is what we would expect where capillary action inside the pleural sac has drawn up and suspends as much fluid as it is capable of sustaining. Such a case is undoubtedly one of pleurisy or empyema.

It is important to know which is present. Can X-rays differentiate? The point is a disputed one. I have discussed this with numerous observers, including

Dr. Levack, Dr. Fowler, Dr. Struthers Stewart, and Dr. Johnston, and I have further made an experiment *in vitro* in that connection, and there seems no doubt that X-rays can render no such service. For the most part the shadow produced by serous fluid is to all intents and purposes as dark as that caused by pus.

Aneurism lends itself very readily to recognition by screening. The abnormal bulging in the region of the base of the heart, with the steady expansile movement synchronous with the heart, has only to be seen to leave a lasting impression on one's mind.

Tuberculosis being by far the most common disease of the lung, it is essential to keep in one's mind the cardinal features of that malady. In particular, two points: firstly, that in the vast majority of cases the disease starts in the apex; and secondly, as first pointed out by Kingston Fowler, that it steadily proceeds in a definite line of march, attacking *seriatim* first one upper apex, then the other apex, next the lower apices, and, lastly, the fifth lobe. It is this knowledge which enables the radiologist to determine that a mass appearing towards either base, or the root—fluid being, of course, excluded—is presumably malignant. Lymphodema and hilus tuberculous disease in the latter case, however, should not be lightly excluded. There are cases I have seen—in all, four—where tuberculosis started in the middle lobe, and it was not till comparatively late that the apices became involved. The cases all had tubercle bacilli in the sputum early and proved fatal. A radiologist might be pardoned if at first sight he committed himself to the view that such cases were malignant.

With regard to technique only two points may be referred to:—

1. *Length of exposure in skiagraphing the chest.* The practice has oscillated greatly. In the early days

three minutes was quite a common period of exposure. Next came the fashion of short exposure, and for some years one-fifth of a second was considered highly desirable. A rebound took place, and operations went back to the long exposures. We have once again returned to the lightning method. It seems the more reasonable, having the advantage of eliminating the disturbing movements of respiration, so it is likely to remain.

2. *The position of the patient while being photographed.* Here also experience has produced a change, this time from the recumbent to the sitting or upright posture. Operators seem to be generally agreed that the results obtained with the patient in this position are better than can be got where the patient lies on his back with the plate either resting on his chest or on the table beneath him.

X-Rays in the Diagnosis of Fractures and Dislocations.

By J. H. DOUGLAS WEBSTER, M.D., M.R.C.P.
Honorary Radiologist to the Middlesex Hospital, etc.

THERE are few fields of medicine and surgery in which X-ray examination has been of more service than in the diagnosis of fractures and dislocations; and the recent advance of general and orthopædic surgery in dealing successfully with these injuries has resulted in great part from the more accurate knowledge gained by X-ray investigation as to the varieties of fractures and dislocations, and the results of different methods of treatment. But in spite of the wide use of X-rays it is probably still true that one of the commonest errors in diagnosis for which medical men have to appear in the law courts is the confusion of a fracture with a sprain (Taylor[1]), and X-ray examination is still far too often omitted from the routine management of patients with injuries.

TYPES OF INJURIES IN WHICH AN X-RAY EXAMINATION IS LIKELY TO BE OF MOST SERVICE.

In all cases in which the clinical diagnosis is doubtful, either as to the presence or not of a fracture, or as to its full extent or the relationships of the fragments, radiographic examination may be relied on to give the necessary information.

Specially valuable assistance may be given thus in "sprains" (about 10 per cent. of which are complicated with fractures), in injuries at and near joints, and where the possibly injured parts lie deeply, and cannot be

palpated or clinically investigated by other means. "Sprains" of the wrist, fractures at and near the elbow-joint, fractures involving the epiphyses of the long bones in children and adolescents, "spontaneous" fractures due to endosteal or other bone tumours, fractures of the ribs, pelvis or spine, and the checking of the results of treatment of congenital dislocation of the hip, may be instanced as examples of sites and conditions where by clinical examination alone a full diagnosis often cannot be made, and the X-ray evidence may be invaluable.

METHODS OF X-RAY EXAMINATION.

Screen examination may be useful to control the manipulations of "setting," and to gauge the weight necessary for extension of a limb. But for excluding the presence of a fracture a negative screen result is of no value, for fissures and slight displacements or impaction are frequently shown on negatives when they have been missed on screening. The image on the fine crystals on the fluorescent screen is a diffused one, and not sharp enough to show up fine detail, in spite of full adaptation of the eyes to the dark room.

A radiograph from one point of view may show a fracture, and be considered a sufficient examination for economic reasons, but a negative result from one film is not enough to exclude fracture, as a fissure in a plane oblique to the incident ray may be invisible, and even fractures with considerable displacement may be missed by the practice of taking only one radiograph.

In all cases, where possible, two views at right angles should be taken, one antero-posterior, the limb in the normal anatomical position, and the other from the side. This may be done by rotating the X-ray tube, or by rotating the patient—the former preferably, as the limb or body remains at rest, and an exact right-angle can more easily be measured. The right-angle views

are best for giving the position of fragments, but any two viewpoints may be chosen, from the small shift of six or ten centimetres which can be combined in a stereoscopic image, to views at wider angles; any two such views will give information more or less accurately as to the positions and relationships of the injured parts of the bone. For complete analysis, stereoscopic pairs at right-angles, even four stereoscopic pairs, may be necessary, for example, in obscure head injuries. And in such more difficult cases angles may have to be employed other than the standard sagittal and coronal plane views.

Radiographic technique has advanced greatly since the Special Number of THE PRACTITIONER on "X-rays in Diagnosis" was published in 1906. Improvement in tubes and the use of the Potter-Bucky diaphragm have made the taking of lateral views of the spine comparatively simple, and the sacrum, sternum, hip, and shoulder can now be shown this way, though in badly-injured patients stereoscopic views are more suitable for pelvis, hip, and shoulder examination.

The radiographic ideal is a maximum of contrast and of detail in the shadows of the parts which have to be demonstrated; thus a good dorsal spine view gives a poor record of lung structure, and *vice versa*. How to attain this maximum of contrast and detail by choosing a suitable quality of ray, and exposing the part for a proper time, cannot be discussed here. General rules are that the part examined must be kept immobile, or a "flash" exposure made; the opposite side of the body should be examined in doubtful cases; and bandages and splints should never be removed without the express permission of the referring practitioner or surgeon.

The examination, in cases of recent injury, should show: (1) The presence or absence of bone or joint injury; (2) the site and type of injury, and the position of any fragments; (3) whether there is involvement of

the neighbouring joints; and in later examinations, (4) whether there are signs of callus or not; and (5) the results of surgical or operative treatment.

LIMITATIONS OF X-RAY EXAMINATION.

(1) The X-rays do *not* show cartilage: thus, they are useless for excluding fractures of the costal cartilages (unless these are partly ossified), dislocations of the semilunar cartilages of the knee, and of the non-ossified epiphyseal cartilages in the young (unless the diaphysis is slightly fractured also, as is often the case).

(2) They do not show soft parts such as ligaments, except occasionally, or in the most indefinite way; and their so clear demonstration of the bones perhaps not only in the past has had a bad effect in focusing the attention of practitioners on attempts to secure and maintain bony apposition, while the vitally important matter of maintaining nutrition of the soft parts was for long neglected in fracture treatment.

(3) Fine fissures with little or no displacement may not be seen (a) if only a single radiograph is taken; (b) if they lie on one surface of a massive bone, such as the tibial head, or situated among other bones, as are the vertebral joints, and no careful stereoscopic examination has been made (thus at operation, fissuring of the head of the humerus has been found, which was not visible on the single radiographs); or (c) if they are in thin bones, which are obscured in view by a thick mass of soft parts, as the lower ribs are in very stout persons, or in patients with enlarged hearts, livers or spleens.

(4) From a radiograph at a later date, one cannot exclude the possibility that a fissured fracture occurred at some previous time. Later-date examinations may give information, but cannot give detailed information as to most old fractures.

(5) If the central ray is perpendicular to the centre of

the negative there will be slight magnification, but no distortion, of an image there; the farther from the centre, however, and the more oblique the ray is, the greater will be the distortion, as can readily be seen by a few experiments with a light held at various positions over two sticks and a sheet of paper. Hence, quite erroneous ideas may be given as to displacement of the fragments of a fracture—for example, one near a joint when the central ray was projected into the joint so as to give a standard joint view. The radiation from a suitably protected X-ray tube is a cone, and shadows are magnified accordingly more and more towards the boundaries of the image; the rays are not parallel as solar rays are. The farther off the tube is the less is the distortion from this cause, both in screening and in taking films.

(6) The radiograph is such a composite group of shadows of all the structures denser than muscle, and of the air in body cavities, between the tube and the film, that the greatest difficulty may be met with in interpretation of any given shadow in a single radiograph. Again, structures seen from different angles often present surprisingly different shadows. And further, only the outer contours of bones may come up clearly—in dense bones this is so even in stereoscopic views. Thus the acetabulum in a congenital hip case may appear to have very ill-developed margins, but at operation quite a well-formed depression may be found; in an old compound-fractured tibia there may be a cavity of some size, which hardly can be demonstrated (except by opaque injection) even stereoscopically. In the first case the acetabulum is seen almost on edge, and its concavity is not seen in single views; in the second case the shadows of the outer borders of thickened bone obscure the inner outline of the cavity. Collaboration between the surgeon and radiologist is more than ever necessary for the fullest use to be

gained from X-ray examination in difficult cases, and too much must not be read into the results of any one method of examination. Thus, for demonstration of cavities, the X-ray examination should follow injection of a sterile bismuth carbonate and medical paraffin and vaseline cream.

INTERPRETATION FALLACIES AND ERRORS.

The above limitations frequently lead to errors of interpretation. Thus, non-union of fractures is diagnosed because no bony structure is seen uniting the fragments—but there may be firm fibrous union, or non-ossified cartilage present; the X-ray can only give ground for reporting "no sign of bony union." Only by first seeing and describing minutely the appearances shown, and secondly by analysing critically each of the shadows, can true interpretations be given in difficult cases: and an essential for full interpretation is knowledge of the details of the relative positions of tube and parts at the time of the examination; without this knowledge very misleading opinions have been formed by third parties, who have attempted radiographic interpretation.

Apart from the above causes it is not possible here to discuss all the errors of interpretation. There are many pitfalls for the inexperienced or unwary. Raper[2] gives a list of forty-one possible mistakes in dental interpretation alone, and says, in this branch of the work, "someone is making a new mistake every day." Errors may be grouped into:

(1) Technical errors in the taking of the exposure, or defects in the negatives or prints in their manufacture, or faults in their manipulation may lead to the missing of fractures that are present, or to wrong diagnosis of fissured fractures, or areas of bone rarefaction, or sequestrum formation in old compound fractures. Many fractures have not been diagnosed because of

imperfect quality in the radiographs—especially in spinal and head injuries.

(2) Errors due to imperfect acquaintance with the radiographic anatomy of the normal bones, joints, and the epiphyses, and bony variations and abnormalities, and the appearances in injury and disease. Thus, in the cranium, the suture-lines, the meningeal vessel impressions and the diploic canals have all led to erroneous fracture-fissure diagnosis. In the hand and wrist, the ten or so possible sesamoid bones, and the twenty-one or so possible small supernumerary bones, may suggest to the inexperienced to make a wrong diagnosis of fracture. Similar errors can occur with the foot and ankle, and with the spine, owing to its many variations. In the limbs, comparison with the uninjured side is often helpful. Variations such as a bipartite scaphoid are usually bilateral.

SPECIAL SITES OF FRACTURES AND DISLOCATIONS.

1. *Head.*—All head injuries of any severity should have X-ray examination as soon as the patient is fit to be examined, as in several large series about 20 per cent. of cases have shown radiographic evidence of fracture. A fresh fracture here, more than elsewhere perhaps, is demonstrable in comparison with the evidence possible to show at a later date, and required because of late results of the injury. Where there are no localizing signs a full examination should be done with anterior and posterior films, and stereoscopic (preferably) views from both sides looking obliquely downwards towards the base. X-ray signs of fracture are, of course, relatively of little importance compared with the injury to the brain: sometimes, however, a large depressed fracture may be found in a silent area with few or no clinical signs of its presence (see, for example, Case 151 in Sharpe[3]). In the orbit and face bones various obliquities may have to be chosen, and

stereoscopic views taken, to demonstrate the existence or extent of fractures. Oblique views from the side and below are required for the mandible near the angle, so as to prevent overlapping of the image of the uninjured side.

2. *Spine.*—The occipital condyles, atlas, and axis are best shown by a view through the open mouth, the head being so placed that the shadow of the occipital crest does not obscure the outlines. This and a lateral view are required for the upper three cervical vertebræ. The rest of the spine may be examined by antero-posterior, lateral and oblique projections, except that a lateral view of the lower cervical and upper dorsal spine is impossible in short-necked persons. Owing to the number of overlapping contours, in old fractures especially, a large number of radiographs may need to be taken for accurate demonstration of the conditions: Koehler[4] says ten or more may be needed in difficult cases. Should the condition be obscure, careful measurement should be made of the total exposure to avoid any possibility of dermatitis resulting.

Fractures of the bodies and of the spinous and transverse processes are usually readily recognized. When the bodies are damaged there is almost always a fracture-dislocation. Demonstration of narrowing of the spinal canal in fractures in tumours may be made by lipoidol injection. Strains of the back may be accompanied by fracture of the transverse processes: Baetjer and Waters[5] note two instances where this occurred in the fifth lumbar in an attempt to make an especially good drive at golf. Incomplete closure of the laminæ (occult spina bifida) at the fifth lumbar is seen in 10–15 per cent. of all cases, and has been noted as present in 60–70 per cent. of a series of cases of nocturnal enuresis (Hofmann). Other variations are common here, and deformities: the slipping forward of the fifth lumbar on the first sacral—spondylolisthesis, is best

seen in lateral views. For clear demonstration of sacral and coccygeal injuries the intestinal tract must be well cleared beforehand.

3. *Ribs and Sternum.* Oblique views may be necessary to show fractures of the ribs with slight displacement when these are on the lateral aspect of the chest wall: absolute immobility of the injured side (next the film) is necessary during the exposure, and is not always obtainable when the patient is restless and in great pain, unless very rapid exposures can be made. The Potter-Bucky diaphragm has helped demonstration of fissures in the lower right ribs, seen through the liver. Fractures of the costal cartilages are not seen unless ossification has taken place, as is common after the 30th or 40th year, and is earliest and most marked in the first costal cartilage. The sternal shadow is best shown by an oblique projection which separates its image from that of the spine and the heart, and lateral views show it well, unless there is much costal cartilage ossification and the cartilages are prominent, the sternum being recessed.

4. *Clavicle and Scapula.*—In the clavicle, X-ray examination is valuable at the extremities, where fracture may simulate dislocation or complicate it. In children an unrecognized subperiosteal fracture may be followed by massive callus formation, which may appear to be a sarcoma: a radiograph should help in the differentiation. The deeper-lying scapular fractures, those involving the glenoid or body, may be impossible to diagnose clinically, owing to swelling and absence of typical signs. Antero-posterior views usually suffice, but if there are fragments, which may be badly displaced near the joint especially, then a lateral view or stereoscopic views should be taken. In fracture associated with metallic foreign bodies, stereoscopic views may not localize accurately the position in front

of or behind the thin shell of the body of the bone: here, as elsewhere, the metallic body always appears nearer to the bone than it is relatively. During the war, before the lateral view method was well known, the writer had a case of this kind in which, viewed stereoscopically from the front, a shrapnel ball appeared in front of the scapula, while it appeared behind when viewed from behind: it was found, at operation, wedged in a well-shown fissure of the body, as was suspected.

5. *Humerus* (*upper*).—Screen examination or a single antero-posterior view may show the essentials of an injury at the upper end, but stereoscopic views should be a routine for the demonstration of finer details. To show the displacement of the lower fragment in fracture at the surgical neck, a view may be taken with the arm in outward rotation, or lateral views may help. Fine fissures can be missed in single views owing to the mass of bone: thus in dislocation with outward rotation, fracture of the greater tuberosity may be missed with only one view (Choyce[6]). The free tuberosity may overlie the main break and obscure it (Perkins, in Binnie's "Regional Surgery"[7]).

6. *Elbow*.—In fractures at the elbow great care has to be taken to elucidate the multiple injuries often present, and stereoscopic antero-posterior and medial and lateral views may be needed, or oblique projections may show displacement best. For example, the broken-off tip of the coronoid process may be obscured by the humerus outlines. In children when the epiphyses are not ossified, or only the capitellum is visible, displacement of the epiphyses may be shown (1) by a slight fracture of the adjacent diaphysis, or (2) by careful attention to the general outline of the forearm and arm bones on the injured side as compared with the normal side, or with normal anatomical or radiographic pictures for the same age as the patient:

sometimes X-ray examination fails to show any abnormality, as in internal epicondylar fractures in children under seven. The common fractures are supra-condylar, and of the external condyle and internal epicondyle.

Y or T fractures into the joint, and other varieties are readily distinguished; and the presence of loose fragments may be shown in a position where they would, if left, cause great disability. Fissures with little or no displacement in the head of the radius may require several projections to be shown clearly. In the olecranon union is rarely bony, so non-union should not be diagnosed from the X-ray appearances of firm fibrous union.

7. *Wrist.*—By clinical examination dislocation of the wrist can only lead to a probable diagnosis without radiographic confirmation. Lejars[8] gives notes of two cases which appeared clearly uncomplicated dislocations by palpation: one was a fracture low down of radius and ulna; in the other there was, in addition, a fracture at the base of the radial styloid. Ten per cent. of "sprains" of the wrist are complicated with fracture (Mock[9]), usually of the radius, as Colles[10] showed 110 years ago. In a considerable percentage the ulnar styloid is also broken off.

For carpal injuries both hands should be compared, with front and profile views at different angles. Fracture of the scaphoid with or without displacement of the outer fragment is now by X-rays recognized to be more frequent than was formerly thought. Dislocation backwards of the scaphoid, or backwards of the os magnum and forwards of the semilunar, may be impossible to diagnose without X-rays owing to the swelling and the tendinous coverings of the wrist. The same is true of Bennett's fracture or other metacarpal and phalangeal fractures, or fractures there complicating dislocations.

8. *Pelvis.*—Fractures of the pubis and ischium are the most frequent, and are readily shown by antero-posterior projections. In children, crushing accidents usually produce separation along epiphyseal lines.

9. *Hip and Femur.*—Dislocation of the hip upwards is shown by discontinuity of the line of Ménard (de Berck) or Shenton, formed by the upper obturator and lower femoral neck contours. Slighter degrees may be shown (Jaugeas[11]) by a line drawn along the Y-shaped cartilage between the ischium and pubis and branching in the acetabulum: the upper branch of the bifurcation should lie above or be tangential to the epiphysis; if it cuts across the head slight displacement is to be considered probable. The results of manipulation and reduction are well shown, and the restoration of the joint to the normal in satisfactory cases can be followed out in the course of months or years. Epiphyseal separation and fractures of the head, neck and trochanters usually present little difficulty in X-ray examination, but slight fissured or impacted fractures of the neck may be missed unless taken from several angles; in children especially their recognition is important owing to the liability of late deformities (Judet[12]). The absorption of the neck, and atrophy of the head in fractures high up in the neck, especially in the aged, may be seen by radiographs at successive dates following the injury. The writer has seen four or five cases of spontaneous fracture of the neck in patients with mammary cancer. In fractures of the shaft the impossibility of maintaining satisfactory position without an open operation may be shown, and the results of plating checked from time to time.

10. *Knee.*—Lower femoral epiphyseal separation may occur, usually with anterior displacement; if the periosteum be stripped, much considerable new-bone

formation may be shown by later examination. T- and Y-shaped fractures through the condyles of the femur, usually accompanied by immense swelling of the knee, are clear on X-ray examination. Slight fractures of the patella may be difficult to demonstrate unless a projection be taken which throws the patellar shadow free from that of the femur; longitudinal fissures may be missed if lateral views only be taken. Sprains of the knee may be complicated by fracture of the tibial spines, which cannot be recognized clinically. The anterior tibial tuberosity ossifies in a variable manner normally, and ossifying centres should not be mistaken for fractures. Schlatter's disease appears in most cases to be apophysitis rather than fracture.

11. *Ankle and Foot.*—Patients frequently report themselves, walking in with "sprained ankles," in whom fractures of various degrees of severity are found, from slight fissures of the fibula or tibia to well-marked Pott's fractures. Clinically, the diagnosis between various ankle dislocations and fractures may be very difficult without recourse to radiography. The abduction and adduction types of Pott's fracture can usually be shown in sufficient detail by antero-posterior and lateral views; the separation of the lateral angle of the lower end of the back of the tibia (Destot's fracture) may not be recognized without lateral stereoscopic radiographs. The further degrees where the astragalus passes upwards between the separated tibia and fibula (Dupuytren's fracture, strictly speaking, though French writers mostly call all Pott's fractures Dupuytren's fractures), and dislocations at the ankle and subastragaloid can all be readily recognized. In all cases X-ray examination should precede reduction, to ascertain the exact nature of the injury, and should be carried out again just before plaster of Paris is applied; for if the results of manipulation are not satisfactory, open operation and reposition may have to be done to

ensure a satisfactory result (Fagge[13]). Fracture of the posterior end of the astragalus may simulate an os trigonum, and similarly one of the proximal medial tips of the scaphoid may appear to be an os tibiale externum. The base of the fifth metatarsal, or tuberosity, may show a supernumerary apophysis, the os vesalianum: it is almost always bilateral when present, and this should prevent its being mistaken for fracture. Fractures of the os calcis will be shown best by lateral views and an oblique projection from above downwards and from behind.

MEDICO-LEGAL POSITION AND INDUSTRIAL AND ATHLETIC EFFICIENCY.

The importance of accurate initial diagnosis for reducing the disablement period after injuries among employees is well recognized by medical men in industrial districts, and by large businesses and insurance companies. In athletes the necessity for X-ray examination is well known; Whitelocke[14] has shown the importance of this, for example, in "sprains" of the shoulder, which are often fracture-sprains of the acromio-clavicular joint, and may lead to prolonged disability, specially if too early movement and massage be given.

The medical protection societies have repeatedly warned their members of the advisability of having X-ray examination in *all* cases in which there is any possibility of a fracture, and the necessity of impressing the importance of this on the patient or his relatives, and of making a note that this advice has been given.

There are still many practitioners who only have exceptional fracture cases radiographed; but as Hey-Groves[15] insists, "There is no reliable method of knowing which cases do require X-ray demonstration except that of taking pictures of all fractures, or suspected fractures, at as early a date as possible." He is against prolonged

manipulations for diagnosis: "If we can see what is the matter with the bone we ought to do so, and if we are going to do this, why submit the patient to a long and painful manipulation?" And he shows that the views of the law courts and of the lay mind and the common-sense view agree, that "An X-ray record should form part of the routine treatment of every bone injury."

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X-Rays in the Diagnosis of Gastro-Intestinal Disorders.

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X-RAYS were not applied successfully to the diagnosis of disorders of the digestive tract before it became known that certain opaque salts could be swallowed in large amount without harm, provided they were free from soluble impurities. To define the normal is difficult, for, even in healthy persons, the size, shape, and position of the viscera differ greatly, and activity (peristalsis) of the hollow viscera is even more at variance with the hitherto accepted "normal." Experience and observation are needed to decide what characteristics are pathological and what variations are compatible with healthy function.

Preparation of Patient.—An aperient may be given forty-eight hours before the X-ray investigation; no aperient or enema after that. If the patient is taking medicinal paraffin, this should be discontinued for several days, and the aperient should be active enough to drive out any remaining paraffin. Meals should be taken as usual, including breakfast on the morning of the investigation.

The Opaque Meal.—Bismuth carbonate, 4 ozs.; sugar-of-milk (lactose) 1 oz., stirred up in half a tumbler of warm water to a creamy drink. The first visit is timed so that the bismuth is taken one or two

hours after breakfast, i.e. when the breakfast has undergone a good deal of gastric digestion, and is being passed through the pylorus freely, if normal.

Upright Examination.—With the outer clothing removed the patient is supported in the upright position, seated on a bicycle saddle, canvas to support the back, tapes under the armpits. With the fluorescent screen the chest is examined: heart, aortic arch, diaphragm action, lungs, root-regions. In the oblique view the posterior mediastinum is inspected for glands, etc. The bismuth is now taken, its passage through the pharynx and œsophagus carefully noted.

The Œsophagus.—Normally the emulsion passes down in a steady stream of uniform diameter to the lower end; here the stream tapers down to the cardiac orifice, and enters the stomach, running down to the greater curvature at once. Sometimes the bismuth passes through the œsophagus in columns, separated by columns of swallowed air; the air collects in the stomach forming a dome-shaped clear region under the diaphragm; usually most of it is voided by eructation soon after, but in ærophagists air is swallowed in far greater amount, and is retained so that it distends the stomach, giving rise to discomfort or distress.

Cardiospasm.—In some cases of food regurgitation, or difficulty in swallowing, the bismuth is held up at the cardiac orifice; only a thin stream goes through. The lower part of the œsophagus is dilated in proportion to the severity of the hold-up. Cardiospasm comes on very insidiously and continues for many years. If untreated the dilatation becomes enormous, and the œsophagus so elongated that its lower end lies horizontally upon the diaphragm. Beyond the cardiac orifice is a cul-de-sac, so that a catheter impinges upon it and cannot be made to enter the stomach except with the aid of a silk guide that has been introduced some

days or weeks previously.

Carcinoma of Œsophagus.—The cardiac orifice is one of the two usual sites of cancer of the œsophagus. Obstruction with irregularity of outline is the characteristic X-ray sign. The other site of cancer is at the level of the bifurcation of the trachea. Normally the right bronchus indents the œsophagus at this place; the indentation is regularly seen during the passage of bismuth. Excessively hot drinks may erode the mucous membrane at this prominence, and food boluses, by their friction, keep up the erosion. Later, a cancer may ensue. With bismuth and X-rays an obstruction and irregularity of outline is seen, and if the growth has eroded the wall of the bronchus, bismuth, when swallowed, is seen to enter the bronchus and radiate along its branches. It is then coughed up.

The Stomach.—In the upright posture the greater curvature should be about level with the umbilicus; with the added weight of 4 ozs. of bismuth, an inch or two lower. In the recumbent positions it lies higher. Gastric peristalsis is best observed in the prone position; normally the waves seem to start at the cardiopyloric junction, become deeper as they travel along the curvatures till they approach the pylorus, where they cut off the pyloric antrum from the rest of the stomach, and then thrust the contents of the antrum into the duodenum.

Pyloric Spasm.—A very prevalent disorder of the stomach is pyloric spasm. The contents of the pyloric antrum, instead of being thrust through the pylorus, are returned repeatedly into the body of the stomach; little or none passes into the duodenum, although with pyloric spasm, gastric peristalsis is usually more powerful than normal; the waves are deeper than normal, and are seen to start nearer the cardiac end.

Pyloric Stenosis.—The passage of numerous waves

must be carefully observed. Organic stenosis is diagnosed if an occasional thin streak of bismuth is forced through the pyloric aperture as the result of exceedingly strong peristaltic efforts; in some cases of obstruction reversed peristalsis is seen; the waves start at the pylorus and proceed along the curvatures toward the cardiac end. The diagnosis of pyloric stenosis is confirmed if, at the end of six hours, there is a large residue of bismuth, and some residue still after twenty-four hours.

Pyloric Cancer.—Irregularities of outline, if persistent, indicate new growth. Sometimes the tumour can be felt.

Gastric Ulcer.—Pyloric ulcer gives rise to tight pyloric spasm; if cicatrised, to stenosis. Ulcer of the lesser curvature causes striking changes, very constant in character in different cases: a niche on the lesser curvature, corresponding to the crater of the ulcer; a deep notch in the greater curvature, opposite the ulcer, due to spasm of the circular fibres of the stomach. This spasmodic hour-glass contraction is permanent, but relaxes under general anæsthesia. Beyond the ulcer the pyloric portion of the stomach is big and baggy; there is pyloric spasm; the duodenum is distended, and there are pronounced evidences of chronic intestinal stasis in the ileum and colon (described later).

Cancer of Lesser Curvature.—There is, in my judgment, ample proof that chronic gastric ulcer may become cancerous. The X-ray evidence is an alteration of the typical niche; its edges become irregular, and as the cancer grows the change of shape becomes more pronounced and extensive. Sooner or later a growth can be felt in the position of the old ulcer.

The Normal Duodenum.—In health, bismuth enters the duodenum from the stomach at once; as soon as the first part is full a peristaltic wave propels the bismuth

into the second (vertical) part, and on, without delay, through the duodeno-jejunal junction. The first part, or "bulb," is hemispherical; its upper border is dome-like.

The Duodenum in Stasis.—In chronic intestinal stasis the duodenum is distended, elongated and dilated; its peristalsis is increased in force, and it is seen to be working against an obstruction—a kink at the duodeno-jejunal junction. In severe cases the "writhing" duodenum is seen: the entire viscus undergoes constant changes of shape and position; its contents are forced into its fourth part by the force of the waves, but are returned again and again to the second part, only an occasional spurt being forced through the duodeno-jejunal junction, after which it courses freely through the coils of the jejunum.

Duodenal Ulcer.—Irregularity of outline of the duodenal bulb is usually due to ulcer. A single acute ulcer or erosion causes either a persistent spasmodic constriction or a wedge-shaped depression at the seat of the ulcer. A chronic duodenal ulcer causes a "crater" analogous to the crater of a gastric ulcer. Apart from the ulcer the duodenum always exhibits the characteristics of the "static" duodenum already described.

The Gall Bladder and Gall Stones.—Distension of the gall bladder can usually be felt by manual pressure below the ribs, and occasionally the gall bladder can be emptied by pressure. Gall stones, if old and encrusted with lime salts, can often be seen, but those of recent formation are transradiant because they consist of pure cholesterin. A valuable new method of ascertaining the presence of gall stones has lately been introduced, but unfortunately it entails some slight risk. The sodium salt of tetrabrom-phenol-phthalein is administered. This is excreted by the liver into the

gall bladder, and, unless the cystic or common duct is obstructed, the gall bladder becomes opaque for a certain number of hours and the cholesterin stones within it appear as clear areas.

The Small Intestine.—The jejunum and upper ileum call for no special observation, unless adhesions are suspected. The lower end of the ileum, however, is often the seat of severe changes in stasis.

Ileal Stasis.—The lower ileal coils are very apt to drop into the pelvis, where their contents stagnate and give rise to toxæmia. The changes which occur in this region are now well known. In persons of feeble constitution the cæcum drops and rotates backward and causes ileal torsion. In more robust persons, the mesentery resists the fall of the bowel, becoming thickened at the point of greatest strain, thus giving rise to an ileal kink.

The Appendix.—Or the appendix takes on the function of a ligament by becoming attached by bands at its base so that it anchors the cæcum and imposes on the terminal ileum a sharply-hooped course to the ileo-cæcal entrance. The appendix becomes distended and congested; in this state it may "flare up" at any moment. The X-ray diagnosis of ileal torsion, the ileal kink and the anchored appendix, involves careful observation and palpation with the fluorescent screen in various postures (supine, vertical, oblique).

The Normal Appendix is shown—partially or wholly filled with bismuth—at some or all examinations from the fourth hour onward. It appears as a sinuous or sickle-shaped thread below or on the left of the cæcum. It is freely movable with the cæcum; its form and position depend entirely on the manipulation applied to it. In thin, lax subjects it can be felt and rolled as a soft, slender cord; no pain is caused. If the appendix is catarrhal or inflamed it feels firmer

and thicker; pressure upon it then causes pain. A fixed or kinked appendix is nearly always catarrhal. Concretions in the appendix are shown as small, oval, relatively clear areas surrounded by the dense bismuth shadow. A peristaltic wave is sometimes seen to drive the bismuth out of the appendix (from tip to base) into the cæcum. Bismuth may enter the appendix again from the cæcum as soon as the wave has subsided. The filling of the appendix seems to be a passive act, while the emptying is due to active peristalsis. Small shot swallowed with game is occasionally seen in the appendix; one, two, or three may occupy its tip. They may remain in it for months and then be expelled into the cæcum, or they may enter the appendix one day and be found in the colon next day.

The Large Intestine.—Normally bismuth begins to enter the cæcum in three or four hours; it reaches the hepatic flexure in five or six hours; the splenic flexure in eight to twelve hours; the rectum in twenty-four hours. At this stage some bismuth may have been passed; most is distributed round the large intestine. In forty-eight hours all the bismuth should have been evacuated.

Abnormalities of the large intestine include: (1) *Delay* associated with (a) *dropping* of the cæcum, transverse colon or flexures; (b) *elongation,* especially of the pelvic colon; (c) *kinking* by bands, especially of the iliac colon (Lane's first-and-last kink); (d) *angulation,* especially at the splenic flexure. (2) *Catarrh* of the big bowel is of very frequent occurrence; it constitutes the several forms of colitis.

Colitis.—Stagnant fæces decompose; the toxic products of bacterial proliferation irritate the mucous membrane, causing it to secrete excess of mucus. The circular fibres of the irritated bowel wall get into a state

of tonic spasm, causing exaggerated sacculation and persistent narrowing. In many cases bismuth fæces are found to stagnate in the cæcum and ascending colon, while small amounts of bismuth mixed with mucus are washed through the rest of the big bowel. A thin streak of bismuth is seen in the descending and iliac colon, giving an X-ray picture highly characteristic of "colitis."

Diverticulitis is, in my experience, a sequel to colitis. The iliac colon is its usual seat; it is recognized by a thin central streak of bismuth and isolated spots of bismuth on either side.

Cancer.—New growth in the bowel is recognized by obstruction to the passage of bismuth and irregularity of outline. The diagnosis of new growth, diverticulitis and most other disorders of the large intestine must be confirmed by a barium enema; no X-ray investigation of the alimentary tract is complete that does not include it.

Barium Enema.—Twelve ounces of barium sulphate and six ounces of colloidal kaolin, suspended in four pints of warm water, are run in slowly from a can. The rectal nozzle is passed in just beyond the anal sphincter. The patient lies on the back. If the bowels have been properly cleared in preparation, the fluid runs through the large intestine freely, reaching the cæcum in one to four minutes, although the can is raised only high enough to allow the fluid to run.

Need for a Complete Investigation.—The separate diseases described in text-books on medicine and surgery are not isolated disorders, but parts of a general failure. Every organ is affected; the first to break down is the one that happens to bear the greatest strain at the time. If, at this juncture, full weight be given to the X-ray findings, the patient may be saved the lamentable results that follow from an incomplete diagnosis.

X-Rays in Diagnosis of Dental Diseases.

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BEFORE discussing the radiographic diagnosis in diseases of the teeth and surrounding tissues it is necessary to consider briefly the normal appearances of these parts.

NORMAL APPEARANCES OF THE TEETH AND SURROUNDING TISSUES.

The teeth are best demonstrated by means of dental films placed in close contact with the lingual aspect of the crown and adjacent alveolus, and present an opacity of almost uniform density with a central area of comparative translucency representing the pulp-cavity and root canal (or canals). With suitable technique the enamel covering the crown is shown as a denser layer as compared with the underlying dentine, but the dentine and cement substance cannot be differentiated. The outlines of the tooth are perfectly smooth and regular.

The shape of the pulp cavity naturally varies in the different teeth; the root canal is seen as a very fine linear translucency in the centre of the root, diminishing in width towards the apex, and generally becoming invisible within a few millimetres of the apex itself. In unerupted teeth, and for a considerable but variable time after eruption, the apex does not present this appearance, but remains "open": the root canal is wider and flares open at the apex owing to the incomplete formation of this part of

the root.

The alveolus presents the ordinary appearance of cancellous bone, with reticular lamellar formation. The alveolar margin is seen to possess a thin, but regular and unbroken layer of more compact bone, and this is carried around the roots of the teeth, forming the lamina dura of the tooth-socket.

Between the root of the tooth and the lamina dura is seen a thin linear translucency representing the periodontal membrane. This fine translucent line passes from the alveolar margin down to and around the apex without any variation in width.

Several local modifications of the above appearances are observed, due to normal anatomical structure, but frequently mistaken for abnormalities of dental origin :

(1) In the upper jaw, the shadows of the anterior nasopalatine foramina frequently fall in the region of the apices of the upper incisors.

(2) The apices of the upper molar teeth are often overshadowed by the lower margin of the maxillary antrum, owing to the obliquity of radiation employed.

(3) In the lower jaw the shadow of the mental foramen is commonly seen in close relationship with the apex of the second pre-molar tooth.

These appearances are a frequent source of error, being diagnosed as osteitis around the apex, or, in the case of the antrum, as dental cyst. The recognition of an unbroken lamina dura and periodontal membrane around the apex of the tooth should, however, effectually dispel any doubts which may arise from these causes.

The diagnosis of dental disease is made when variations occur in the appearances described above as normal, and the variation may affect the tooth, the periodontal membrane or the surrounding alveolus; frequently two, or all three, of these structures are involved in the same instance.

ABNORMAL APPEARANCES OF THE TEETH.

Before dealing with actual disease of the teeth, it is necessary to refer to those developmental abnormalities the importance of which is not confined wholly, or chiefly, to prosthetic dentistry. By far the most common abnormality of general rather than special interest is the occurrence of a misplaced lower third molar tooth. This tooth may be found far from its normal situation, sometimes high up in the ascending ramus of the mandible, and is one of the common sources of dentigerous cyst formation. It is more usual, however, to find the tooth in a more nearly normal position, but lying obliquely, so that the crown is impacted against the second molar, or placed of necessity so far back that the posterior cusp is impacted in the ascending ramus of the mandible.

The presence of a tooth so placed is a not uncommon cause of trismus, adenitis, or pain referred to the ear: the onset of symptoms generally coinciding with an infection around the incompletely erupted crown. The possibility of caries is also by no means remote.

A dentigerous cyst may, of course, occur in connection with any retained tooth; the radiographic diagnosis is made on the appearance of a translucent area in the alveolus, usually round or oval, with a slightly condensed bony wall; projecting into the cyst cavity is seen an opacity which may appear as a fully formed tooth, or as an irregular dense mass bearing but little resemblance to the fully formed structure.

Other developmental abnormalities such as absent or supernumerary are usually of dental rather than general interest.

Caries is seen in a radiogram as a translucent area with smooth margins in the crown or neck of the tooth. The condition is readily recognized if the cavity is seen in profile, as a break is then shown in the surface of the

tooth; but small cavities in the inner or outer wall of the crown may be readily overlooked.

Pulpitis in the acute form provides no grounds for radiographic diagnosis, and this may also hold good in the chronic form of the disease; so that a normal radiographic appearance of the pulp-cavity in no way negatives the probability of inflammation of the pulp. Sometimes, however, definite changes are seen in chronic pulpitis: the pulp-cavity becomes diminished owing to encroaching calcification, and may even appear obliterated. In other cases small round opacities due to "pulp-stones" may be seen in an otherwise normal pulp-cavity. The significance of these stones as indicating inflammatory changes is, however, not completely free from doubt.

Sclerosis of the roots, with or without the formation of apical osteoma, and absorption of the roots, are changes seen in periodontal disease and apical osteitis, and will be discussed more fully below.

ABNORMAL APPEARANCES OF THE PERIODONTAL MEMBRANE AND SURROUNDING ALVEOLUS.

Periodontitis.—Acute periodontitis produces no recognizable variation from the normal X-ray appearances. It is in the chronic form of the disease that radiographic examination has acquired a place of unequalled importance.

Radiographically, chronic periodontitis assumes one of two forms, which may be described as the marginal and the generalized; the term generalized is used as applying to any particular tooth: either form of the disease may be seen in one tooth only, though it is more common to find several involved. In very advanced periodontal disease the distinction between the two types is often lost.

The *marginal* type of disease shows a progressive absorption of the alveolar margin. The first radio-

graphic change is loss of the angle formed by the compact bony layers of the alveolar margin and the lamina dura. This loss represents destruction of the most superficial part of the tooth socket, with exposure of the cancellous bone to the surface.

As absorption of the margin proceeds more and more of the root is exposed, but the periodontal membrane around the deeper portion of the root usually maintains a comparatively normal contour and width in the radiogram. Eventually this progressive marginal absorption may extend to the apex, the entire socket being destroyed. The disease may, however, become arrested, especially in the earlier stages, and the eroded margin of the alveolus then develops a compact surface larger, thicker, and more irregular than the original alveolar cortex.

If this occurs, widespread sclerosis may develop in the alveolus, as shown by general increased density, with thick, dense, irregular lamellæ, and partial obliteration of the cancellous spaces. Diffuse alveolar changes of this nature are generally conspicuously absent in active, progressive, marginal periodontitis.

The radiographic appearance of arrested bone disease does not necessarily indicate that the tooth can be saved, as absorption may be taking place from extensive pocketing in the gums.

In the *generalized* type of periodontitis the periodontal membrane becomes thickened; this is seen in the radiogram as an increased width of the translucent line separating the tooth from the lamina dura of the socket. The periodontal thickening is usually fairly uniform in degree around the whole root of the tooth, from alveolar margin to apex.

Marginal absorption is usually absent and the lamina dura becomes increased in width and density as a result of sclerosis. Increased density and irregularity in outline

of the root of the tooth are also commonly seen, sometimes with formation of an apical osteoma, and diffuse osteosclerosis of the alveolus is by no means infrequent, especially where several contiguous teeth are similarly affected.

This form of periodontal disease does not show the same tendency to progression as the marginal form, so far as the periodontal thickening is concerned, but repeated examinations at long intervals often show a gradual increase in sclerosis of the lamina dura and surrounding cancellous bone. Occasionally marginal destruction supervenes in the generalized type of disease with ensuing gradual destruction of the tooth socket.

Apical Osteitis is nearly always (if not invariably) due to spread of infection from the pulp-cavity. In both acute and chronic forms the point of paramount importance in X-ray diagnosis is the recognition of a break in the normal line of periodontal membrane and lamina dura around the apex.

In the acute form, resulting in alveolar abscess, other radiographic changes may be by no means conspicuous. Careful examination will, however, nearly always reveal an irregular area of rarefaction in the alveolus around the apex, with loss of detail in the lamellar bony structure. At a later stage a small opacity may be seen in this rarefied area, indicating sequestrum formation. In chronic apical osteitis the normal line of the periodontal membrane is first modified as the result of periodontal thickening around the apex.

At a later stage of development a break is seen in the normal line of the lamina dura, this being expanded, so to speak, so as to form the walls of a rounded translucent area directly continuous with the normal line of the periodontal membrane around the more superficial portion of the root. The area of translucency, which represents an encysted granuloma, may gradually

increase in size or may remain stationary over long periods.

Not infrequently the granuloma is absorbed and the translucent area is then seen to become less obvious, owing to formation of new bone.

In some instances the occurrence of an old apical osteitis can only be recognized by the presence of a faint ring of condensed bone around a tooth apex; the granuloma itself apparently having been entirely replaced by new cancellous bone formation.

More or less absorption of the apex of the affected tooth is very often seen in chronic apical osteitis.

It is necessary to point out that osteitis may remain around roots left by incomplete extraction, and as these roots may be entirely buried, X-ray examination must include denuded areas of the alveolus when searching for a possible dental focus of infection.

In conclusion, it may be advisable to touch briefly on the relative importance of the different types of periodontal and apical infection as causative agents in the production of remote symptoms due to septic absorption. Many views have been advanced on this subject, but I am convinced, from personal experience, that no distinction whatever can be drawn between these forms of disease as regards their liability to produce any of the disorders recognized as being due to focal infection.

Practical Notes.

Diagnosis of Cerebro-Spinal Fever in Infants.

T. Mogilnicki points out that cerebro-spinal fever is a disease which is particularly frequent in early infancy, and presents many difficulties in diagnosis, as the symptoms usually differ from those observed in older children and adults. While in the older patients there is a sudden onset, with shivering, vomiting, headache, and rigidity of the neck, in infants, on the contrary, the onset is insidious, without typical meningeal symptoms, and an erroneous diagnosis of typhoid fever or pneumonia is not infrequently made. Nervous excitability and abnormally increased tension of the fontanelle are nearly always present; lumbar puncture should always be performed for diagnostic purposes.—(*Archives de Médécine des Enfants*, August, 1925, p. 476.)

The Dick Test for Susceptibility to Scarlet Fever.

W. A. Brown publishes the result of an investigation into the question of susceptibility to scarlet fever by the employment of the Dick test in a series of 487 cases. He comes to the conclusion that when a patient, who gives no previous history of the disease, shows a well-marked positive skin reaction, there is strong presumptive evidence that his or her immunity to scarlet fever is slight or absent. The records of nine cases in the series which developed typical scarlet fever subsequent to the test confirm this conclusion, although it is impossible to be dogmatic on the results in such a small number of cases. The Dick test is, in the author's opinion, a valuable aid to diagnosis, and a strongly positive skin reaction in the first forty-eight hours of a scarlatiniform eruption would lead one to hesitate before making a diagnosis of scarlet fever. When a patient, who has recently shown a positive Dick reaction, develops a scarlatiniform attack, the reappearance of the red area at the site of original inoculation is confirmatory of a diagnosis of scarlet fever. The results of the test demonstrate that age-susceptibility is highest at a period before the child begins to attend school, while age-incidence is greatest during the first few years of school life. The well-recognized fact that an attack of diphtheria increases the patient's susceptibility to scarlet fever was confirmed by this investigation.—(*British Journal of Children's Diseases*, July–September, 1925, p. 171.)

The Technique of Blood-Taking for Diagnostic Purposes.

M. Jonesco says that the medical practitioner, to avoid trouble and inconvenience, should adopt once and for all a particular method of taking blood for diagnostic purposes and keep to it. He points out that to use a needle only is not a good technique, as often the vein is missed, especially in women patients, the blood runs badly and

clots quickly, and the patient may be upset at the sight of the blood. For such purposes as blood-urea examination or the Wassermann test, therefore, he advises that an all-glass 10 c.cm. to 20 c.cm. syringe should be used, and the vein punctured with the needle fitted to the syringe. The needle should have a calibre of at least one millimetre. After the usual bandage is applied, the fist should be closed and the arm stretched to make the veins stand out, and the vein felt, not looked for. The needle is inclined at an angle of 50 degrees to the skin, and, as the puncture is made, rather sharply, the needle is pushed in more parallel to the vein. Once the vein is properly entered, the blood runs by itself into the syringe to the requisite amount.—(*Journal des Praticiens*, October 24, 1925, p. 698.)

Blood Coagulation Time in Skin Diseases.

J. von Deschwanden has found, in the investigation of various skin diseases, that, particularly in eczema, the blood coagulation time was abnormally long. While in normal individuals the range of the clotting time was found to be from 35 to 39 minutes, in cases of old-standing recurring eczema the coagulation time was prolonged to from 53 to 66 minutes.—(*Dermatologische Wochenschrift*, October 10, 1925, p. 1499.)

The Sedimentation Test in Gynæcology.

J. L. Baer and R. A. Reis have made a study of sedimentation tests in one hundred gynæcological cases, and come to the conclusion that the test is a valuable one in determining whether or not there is an infection present in the body. In pathological conditions of the pelvis, for example, pelvic infection can be definitely excluded when the sedimentation test is negative—that is, when the sedimentation time is over two hours, the rate of sedimentation being directly proportional to the virulence of the infection.—(*American Journal of Obstetrics and Gynæcology*, September, 1925, p. 397.)

Early Diagnosis of Diabetes Mellitus.

H. O. Mosenthal insists that the early diagnosis of diabetes mellitus is most important, as if the greatest good is to be accomplished for the patient treatment must be begun at the earliest possible moment. There is no means for early diagnosis that surpasses the availability of routine urine analysis, and in cases where there is a suspicion that diabetes may exist this should be performed once a month. The tests to be employed are the Fehling-Benedict procedure, fermentation with yeast, and the phenylhydrazine crystals. If the urinary tests prove inconclusive, the blood-sugar should be resorted to. If the blood-sugar is 0·140 per cent. two hours or later after a breakfast rich in starches, we may suspect that the sugar tolerance is lowered; if it is 0·150 per cent. or higher we may be certain of it. A patient with a normal glycæmia from 0·090 per cent. to 0·120 per cent. before breakfast, may show an abnormally high blood-sugar level after breakfast, and it is not

probable that the diabetic will maintain his so-called normal blood-sugar after his meals. If a normal degree of glycæmia exists two hours or more after breakfast we are fairly safe in believing that no diabetes mellitus exists. If the blood-sugar is no higher than 0·140 per cent. we cannot be quite so sure of our ground. An increased blood-sugar signifies a diminished carbohydrate tolerance, but every instance of lessened carbohydrate tolerance is not diabetes. When all other means fail to determine the significance of transient or doubtful traces of glycosuria recourse may be had to the sugar tolerance tests. One hundred grains of glucose are given to the fasting subject, and the urine collected at the end of two hours and again for the next twenty-two hours. A trace of sugar (up to 0·2 per cent.) in the first specimen and no sugar in the second specimen are supposed to indicate that no diabetes mellitus is present; higher amounts of sugar are supposed to make the diagnosis of diabetes. The early diagnosis of diabetes is not always an easy matter, and doubtful cases must be observed carefully over a long period before a final opinion is given.—(*Medical Journal and Record* (New York), November 4, 1925, p. 534.)

Diagnosis of Whooping-Cough.

S. Meyer and E. Burghard, in a study of 442 cases of whooping-cough in infants under the age of one year, 423 between the ages of one and three, and 199 in children over the age of three, point out that especially in the younger children the whoop is often absent, and that by waiting for it before making a diagnosis of the disease, an epidemic may become established. Points in the early diagnosis are the extreme restlessness of the infants, they cry, with rapid breathing, cough frequently, knock their heads against the sides of their cots, and throw their limbs about. Attacks of sneezing or yawning may begin or substitute the ordinary whooping-cough paroxysms.—(*Zeitschrift für Kinderheilkunde*, September 28, 1925, p. 103.)

Complications of Lumbar Puncture.

J. D. Perkel notes that in 1,600 cases in which he has performed lumbar puncture for diagnostic purposes, although no fatality occurred, in 322 cases signs of meningism arose, and persisted for from one to ten days. The cause of this untoward complication, the author suggests, was probably the escape of cerebro-spinal fluid into the epidural space; or it may have arisen from cerebro-spinal shock or a reflex on the vasomotor centres caused by the puncture.—(*Presse Médicale*, October 3, 1925, p. 1320.)

Diagnosis of Diseases of the Liver.

C. H. Green, C. S. McVicar, W. Walters, and L. G. Rowntree state that the determination of the serum bilirubin and the phenoltetrachlorphthalein test promise to be of very definite assistance in the study of patients with abdominal carcinoma and suspected malignant disease of the liver. When extension of the malignant process to the liver is accompanied by jaundice, as from abstraction of the

extrahepatic bile passages, it is direct evidence of a disturbance in the normal physiological activity of the liver. In such cases functional tests and the determination of the serum bilirubin are of value in that they furnish a sensitive and quantitative means of studying the effects of the jaundice. The tests are of less value in differential diagnosis, for the jaundice dominates both the clinical picture and the laboratory findings. It is, however, in the study of patients with carcinoma involving the liver, without jaundice, that functional tests are of greatest value. In the absence of clinical evidence of hepatic involvement, the phenoltetrachlorphthalein test may furnish the only evidence of metastatic nodules in the liver. Positive tests are not obtained in all cases of metastatic involvement of the liver, for positive tests are a measure of the interference with the activity of the liver as a whole, and it is an organ with a large margin of safety. For this reason, however, positive tests when obtained become doubly significant.—(*Archives of Internal Medicine*, October 15, 1925, p. 542.)

The Estimation of the Liver Function.

C. W. McClure, W. L. Mendenhall, and M. E. Huntsinger state that one of the most promising means of obtaining information concerning an organ's functional condition is the study of that organ's secretions or excretions, and in the case of the liver the bile is poured into the intestines and may be obtained for study by means of the duodenal tube. The procedure employed by the authors is as follows: the duodenal tube is swallowed before breakfast on an empty stomach; the metal tip is allowed to pass into the second portion, as determined by X-ray screening. The subject then reclines on the right side and a mixture of 5 c.cm. of oleic acid and 45 c.cm. of tap water is introduced into the duodenum through the tube. After about fifteen minutes have elapsed, collection of duodenal contents is begun by siphonage. As soon as bile appears, the collecting flask is changed, and collection carried out for a period of thirty minutes, provided there is no gross change in the colour of the bile, as, for instance, from pale yellow to dark brown or deep green. If a marked change in colour does occur, the collecting flask is again renewed and the duodenal contents collected over a period of the ensuing thirty minutes. Observations on normal subjects showed that introducing oleic acid into the duodenum always gave rise to a flow of definitely brown bile. The minimum and maximum concentrations of the four constituents of this bile are as follows: cholesterol concentration from 30 to 213 mg., pigment concentration from 100 to 500 per cent., bile acid concentration from 80 to 212 per cent., bilirubin concentration from 6·7 to 23·5 mg. On a basis of these observations it is considered that the figures given for the four biliary constituents establish the limits of their normal variation.—(*Journal of the American Medical Association*, November 14, 1925, p. 1537.)

Comparison of the Kahn with the Wassermann Test.

M. H. Faupel has taken specimens of blood from a series of 400

patients, and employed both the Kahn and the Wassermann tests for purposes of comparison. In the Kahn test the antigen consists of a 0·5 per cent. cholesterinized alcoholic extract of beef heart muscle, which has been titrated to determine the proper proportion of antigen and salt solution to mix for the tests. The undiluted serum is heated at 56° C. for 20 minutes, and 0·15 c.cm. of the patient's serum is then added to each of three tubes containing 0·05, 0·025, and 0·0125 c.cm. of the antigen saline mixture. Readings are recorded on the basis of +, ++, +++, ++++, depending on the distinctness of the precipitate. The final result is the average reading of the three tubes. 90·2 per cent. of the specimens showed absolute agreement with the Wassermann test, 3·8 per cent. good relative agreement, 5 per cent. partial agreement, and 1 per cent. absolute disagreement. The Kahn test is of especial help in cases in which rapidity is an important factor.—(*Bulletin of the Johns Hopkins Hospital*, September, 1925, p. 170.)

Comparison of Diagnostic Tests for Syphilis.

C. Schuler has made a comparison of the Wassermann, Sachs-Georgi, Dold, and Meinicke tests for syphilis in 5,000 cases. He found that the test which gave the largest number of positive results in syphilis, and the smallest number of mistaken positive results, was the Wassermann. The Sachs-Georgi was the best of the other three, but gave confusing results in cases of tuberculosis, enteritis, and arthritis; the two other tests gave many wrong positive results. —(*Schweizerische Medizinische Wochenschrift*, October 1, 1925, p. 911.)

A New Rectoscope.

R. Savignac describes a new instrument which he has constructed for the purpose of examining the rectum. It is composed of a pentagonal prism, which forms the centre of the apparatus, at right angles to which are two telescopic tubes, containing lenses, through one or other of which the examination is made. A third tube, in the same plane as one of the examination tubes, is of various interchangeable sizes, and is introduced into the rectum. The apparatus allows two persons to make the examination at the same time, and, according to Dr. Savignac, is an improvement on other similar methods of examination.—(*Paris Médical*, November 28, 1925, p. 414.)

Examination of the Cerebro-Spinal Fluid in Malaria.

R. Monteleone has investigated the condition of the cerebro-spinal fluid in cases of malaria, and found that in 50 patients with malaria parasites present in their blood the cerebro-spinal pressure rose proportionately with the temperature, and even in the intervals between attacks the pressure not infrequently remained above the normal. In acute cases the sugar content of the fluid was high, and in some cases of pernicious malaria the albumin content was high, and lymphocytosis was present. In old chronic cases the cerebro-spinal fluid was normal.—(*Il Policlinico*, September 1, 1925, p. 470.)

The Diazo Reaction in the Diagnosis of Bilirubinæmia.

G. Piotrowski discusses the various methods employed for the quantitative examination of the bilirubin in the blood, and finds that van der Bergh's reaction, as modified by Thannhauser and Andersen, is the most reliable method. The retention of bilirubin in the blood can be diagnosed by the aid of the diazo reaction, even when clinical evidence is absent.—(*Presse Médicale*, September 12, 1925, p. 1222.)

The Diagnosis of Subphrenic Abscess.

R. Dexter gives detailed notes of six cases of subphrenic abscess, all of which emphasize the facts that the condition is of insidious onset, and that early diagnosis is infrequent. On account of the lack of physical signs pointing directly to the subdiaphragmatic location of the infection, the condition is often confused with some post-operative inflammation within the thorax; in each of the cases reported there was dullness, diminished breathing, and diminished or absent fremitus on the affected side. The movements of the costal margin and the position of the liver may be misleading, depending upon the anatomical location of the subdiaphragmatic inflammation. The most important and the most definite aid to the diagnosis is X-ray examination, which should be repeated; in all six of the reported cases it was found that the diaphragm was displaced upwards, was more acutely arched than normal, and diaphragmatic motion on the affected side was lost.—(*American Journal of the Medical Sciences*, December, 1925, p. 810.)

The Œsophagoscope and X-rays in the Diagnosis of Œsophageal Disease.

C. J. Imperatori insists that in the correlation of subjective symptoms and clinical findings, including radiography, in conditions referable to the œsophagus, endoscopic examination is of major importance. Visually, the lesion producing the symptoms may be studied and the nature of the condition determined. The X-ray findings, with a proper interpretation, should be available before and during endoscopic examination. Dilatations are not so striking by means of the œsophagoscope as when seen radiographically, with the œsophagus filled with some opaque fluid, when kinks and changes in normal direction are also easily made out. There may be occasions when œsophagoscopy is contradicted and the X-ray findings must be accepted. A more correct diagnosis, however, is always obtainable when the two methods of investigation are employed conjointly.—(*Archives of Otolaryngology*, November, 1925, p. 441.)

The Value of Examination of the Blood-pressure.

S. Katzenelbogen notes that the examination of the blood-pressure gives valuable indications not only regarding the cardio-vascular system, but also regarding the functioning of the kidneys

and the suprarenal capsules. In an indirect manner the blood-pressure gives information about the anatomical condition of these organs, proof of which is frequently seen at autopsy. A high blood-pressure is sometimes the only symptom to indicate any departure from normal health; the amount of the tension that can be borne by the individual varies in different cases, and some persons may live to an advanced age with a very high blood-pressure.—(*Revue Médicale de la Suisse Romande*, December 25, 1925, p. 897.)

A Skin Test for Cerebro-Spinal Fever Immunization.

M. Erlich, assisted by co-workers, has made intradermal injections with the toxin from cultures of the meningococcus, in 82 individuals between the ages of one and twenty years. In 45 cases the reaction was positive, in 28 negative, and in 9 it was indefinite. The positive reaction cases were not influenced at all by the injection of a non-specific serum. The principle of this new intradermal test is the same as that of the Schick and Dick tests.—(*Comptes Rendus de la Société de Biologie*, October 23, 1925, p. 943.)

Value in Diagnosis of the Cerebro-Spinal Fluid Sugar Content.

MM. Fontanel, Leulier, and Rouquier have come to the conclusion from a series of examinations of the cerebro-spinal fluid that the sugar content of the fluid is of considerable value in diagnosis. This is particularly so in the differential diagnosis of tuberculous meningitis from encephalitis lethargica, the sugar content being usually increased in the latter. A diagnosis should not, however, be based on increased sugar content alone, as this may be present even in normal individuals.—(*Annales de Médecine*, September, 1925, p. 186.)

The Schick Test for Diphtheria Immunization.

I. Nasso has found that if the Schick test for diphtheria immunization is repeated after ten or fifteen days it is definitely weakened. Three or four repetitions were enough in most cases to change the response from positive to negative.—(*La Pediatria*, November 1, 1925, p. 1141.)

The Electrocardiograph in the Diagnosis of Coronary Embolism.

F. A. Willius reports two cases of coronary embolism, in both of which the chief symptoms were sudden attacks of pain in the region of the heart; the heart-sounds showed no notable abnormality, the pulse was regular, the blood-pressure approximately normal, and X-rays showed an apparently normal heart in both cases. Examination by the electrocardiograph showed in each case very definite modifications in the tracings, evidently due to a block. A number of the electrocardiograms are printed as illustrations.—(*Archives des Maladies du Cœur*, November, 1925, p. 712.)

PRACTICAL NOTES

Diagnosis of Pulmonary Tuberculosis in Children.

S. Singer points out that the diagnosis of pulmonary tuberculosis in children is one of the most difficult to make. In percussing a child's chest, it is important to remember that the chest wall is very thin, and, therefore, one will elicit more if very light percussion is used. A great aid in the diagnosis of tuberculosis of the tracheo-bronchial glands in children is the finding of paravertebral dullness; this is an impaired resonance between the scapulæ, which often extends upwards to the supraspinous fossæ. The voice sounds in a child's chest are greatly exaggerated. A negative Von Pirquet test, if repeated, absolutely rules out tuberculosis up to the age of five or six years, but becomes more unreliable as the child grows older. A positive sputum clinches the diagnosis. The X-rays are of great value in the diagnosis of pulmonary tuberculosis in children, especially in cases of enlarged tracheo-bronchial glands, but too much stress must not be laid on the X-ray findings only.—(*Archives of Pediatrics*, November, 1925, p. 715.)

The X-ray Diagnosis of Gastro-Jejunal Ulcer.

A. B. Moore and W. J. Marquis state that in eliciting the direct radiological signs of gastro-jejunal ulcer the most important evidence is obtained by careful and thorough palpation, so exercised as to expose and permit proper exploration of the stoma and contiguous portions of the stomach and jejunum. This is best accomplished by lifting the overhanging portion of the stomach with one hand and carefully manipulating the field of the stoma with the other, separating the folds of the stomach and small bowel, and searching carefully for any abnormalities. The patient should be rotated in different directions so that different angles of view may be obtained. The first passage of the opaque medium through the stoma should be carefully observed, for at this time irregularities may be noted that are later hidden by the barium in the bowel. Deformity of the stoma appears as a retraction and drawing up of the greater curvature; it may be due either to spasm or to cicatricial contraction. Either retraction of the stoma or narrowing of the jejunum may cause a scant flow of barium, which is of great diagnostic value. Fixation of the stoma, when noted, is of diagnostic importance. During palpation of the stomal area close observation should be made for possible craters, which appear as small localized areas of greater density due to the retention of barium in the cavity. While these craters do occur, they are not, in the authors' experience, nearly so common as some observers believe.—(*American Journal of Roentgenology*, November, 1925, p. 432.)

Differential Diagnosis between Fibroma and Pregnancy.

Forget Urion points out that while the symptoms and signs of a uterine fibroma usually differ markedly from those of pregnancy, sometimes the differential diagnosis may be difficult, as a fibroma may have some of the symptoms of pregnancy, or may be com-

plicated by pregnancy, or, again, the pregnancy may not be typical. and may have some of the symptoms of a fibroma. Usually the diagnosis of pregnancy depends on the cessation of the menstrual periods, the softening of the cervix uteri, the rapid and regular growth of the tumour, the presence of milk in the breasts, etc.; while in the case of a fibroma there are periodical hæmorrhages, the cervix is sclerosed, and the tumour is hard, often irregular, and of slow development. Sometimes, in the case of a fibroma, the menstrual periods may be irregular, or have ceased (at the menopause); the tumour may grow rapidly (in, for instance, malignant degeneration); and milk has been reported (by Commandeur and by Hartmann) to be present in the breasts. On occasion, in pregnancy, there may be irregular hæmorrhage, and the cervix may be sclerosed. Time, in most cases, will confirm the diagnosis, but the employment of X-rays is a most valuable aid to precision, although a negative radiogram before the end of the fifth month is valueless.—(*La Gynécologie*, October, 1925, p. 584.)

The Diagnosis of Gonorrhœal Vulvo-vaginitis.

Sara A. Scudder comes to the conclusion that in cases of vulvovaginitis the diagnosis should depend upon smears and cultures from the urethra, vulva, vaginal introitus, upper vagina, and cervix. Smears are best when made with sterile slender cotton swabs which are evenly rolled, not rubbed, over sterile glass slides. Staining should be controlled by the use of known gram-positive and gram-negative organisms, such as staphylococci and *B. coli*. Persistent extra-cellular, gram-negative, biscuit-shaped diplococci in freshly-made and carefully-stained films from the genito-urinary tract of children are presumptive evidence of gonococcal infection, even in the absence of confirmatory clinical and cultural findings. The presence of the gonococcus in the genito-urinary tract of children is not always attended by positive clinical signs; nor is there always a predominance of pus cells in those secretions which contain gonococci. Epithelial cells frequently harbour the organisms. The modified Thalmann medium, as described by Torrey and Buckell, appears to be the best differential medium yet devised for the isolation and maintenance of gonococci. The fermentation test is, at present, the only means whereby the gonococcus can be differentiated from other gram-negative diplococci, the gonococcus fermenting dextrose only.—(*Journal of Urology* (Baltimore), November, 1925, p. 429.)

Estimation of Calcium in the Blood and Urine.

J. S. Sharpe describes a simple and rapid method of estimating the calcium in the blood and urine. It depends on the formation of a cloud by the addition of oxalate of ammonium to a protein-free calcium solution in glycerine, and a comparison of this with a similar cloud in a standard solution by means of a simple nephelometer, which can be made in a few minutes from a small cigar-box and two test-tubes. Dr. Sharpe gives full details of the method —(*Edinburgh Medical Journal*, January, 1926, p. 27.)

(So great was the demand for our last Special Number on Dietetics that we offer no apology for issuing another number on the same subject brought up-to-date. We do not propose to utilize valuable space by commenting on the individual articles, but will leave them to the considered judgment of the reader, being convinced that he will find a great deal of practical value which will help him in his duty to his patients, and assist in the making of a healthier population.)

THE PRACTITIONER

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The Doctor and Dietetics: Some General Principles.

BY SIR KENNETH GOADBY, K.B.E., L.R.C.P., D.P.H.

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THE literature of all civilized countries abounds with references to the advantages and disadvantages of food, of the choleric effects of beef and mustard, and the humours attributable to starchy articles of diet, but the present useful issue of THE PRACTITIONER dealing with foods and their advantages and disadvantages from many points of view may be aptly summed up in the plaintive wail of Katherine: "I care not what so long as it be wholesome food." Here is the crux of the matter: "What is wholesome food?" We know the old saying, "What is one man's food is another man's poison," and, again, the country advice, "Feed a cold and starve a fever," or Sydenham's philosophic epigram, "He that hath attained unto the age of forty abateth himself somewhat of his diet be he not a fool." As civilization has advanced and man has ceased to depend upon a

precarious diet of uncooked roots, fruits, and berries, and has substituted for it an accumulation of vast stores of food, a great change has taken place in the concentration of food substances as well as in their consistency. Modern physiological investigations emphasize the necessity of adequate bulk of foodstuffs, besides a sufficient supply of the three cardinal constituents of diet—protein, carbohydrate, and fat—and finally, the necessity of some material, such as salad, containing those antiscorbutic, and other factors without which both growth and maintenance of health are impossible—the vitamins. There are two other essential constituents: the inorganic salts, mainly derived from vegetable food, and the substance so often neglected in the estimation of diets, namely, water. The human body contains at least 85 per cent. of water; all the chemical exchanges in the ultimate cells depend on an adequate supply of water as well as the discharge of waste products from the body. From the point of view of the doctor, dietetics are divisible into two categories: (1) the normal diet to maintain a vigorous and healthy body in average health, or to enable the young and vigorous child to develop normally, both physically and mentally; (2) in disease and pre-disease conditions, which articles of diet should be avoided, which should be taken. Now these two problems, whilst having many factors in common, are not quite identical. The calories given off by different foodstuffs when subjected to analysis in the calorimeter are the basis upon which the quantities are calculated, that govern the amount of diet in severe illness or the amount of food provided for a family of growing children, although in practice calories per gramme weight of food must be turned into, say, spoonsful of porridge. The amount of food will vary with the work done, with the body-weight of the person, or, as is more usually accepted,

the surface area. A fat person lying in bed will require less food than a thin person engaged in exercise These, however, are extremes upon which dietists are agreed; what becomes difficult and a source of concern to the doctor is to advise a diet adequate in amount for a person who, whilst not suffering from a frank and declared disease, is yet in a condition of ill-health or a pre-disease state. To do so it is necessary to know whether the primary food constituents are improperly, partially, or inadequately utilized. In other words: Is the metabolism of the person it is sought to help normal on a normal diet? How far does the metabolism of protein carbohydrate fat—salts and water—depart from normal?

For purposes of illustration we may conveniently regard food which is assimilated as passing along the two arms of a Y. Along the one branch the food is turned into body growth, increase of body weight, and repair of tissue waste; along the second branch, into energy required by basal metabolism, or the internal energy of existence at rest and the output of external energy, of mental and physical activity.

The evaluation of the components of the first branch is difficult, but the estimation of the second series is approachable by direct chemical methods. To advise a choice of diet in the state of ill-health which precedes most forms of chronic disease, we require to know the nitrogen distribution in the blood and excretions; fortunately, the main quantity of nitrogenous refuse is discharged in the urine, only a very small amount in the fæces.

Folin has shown that the nitrogenous metabolism of the body is very closely pictured in the nitrogenous excretion in the urine, and that whilst the urea nitrogen represents the assimilated food nitrogen (exogenous nitrogen), the creatinine nitrogen, and, to some extent, the uric acid nitrogen, represent the cell activity of

the body (endogenous nitrogen). The creatinine content of the urine remains remarkably constant under all sorts of variations in diet, whereas the urea nitrogen undergoes variations corresponding to the intake of proteid food. Great improvements have been made in the estimation of the non-proteid nitrogen of the blood, and it is now comparatively easy to make a quantitative analysis of the blood nitrogen, and correlate this with the nitrogen excretion in the urine. Failure of carbohydrate metabolism is too well known to be more than referred to in passing, but it is the correlation of the nitrogenous elements, and more especially the percentage nitrogen distribution of the waste products, that give a clue to the breakdown or early impairment of the nitrogenous metabolism of the body.

What is essential for clinical dietetics is not *how much* of the intake of nitrogen is excreted in the various forms of waste products, but rather what the *relative* proportions of the various nitrogenous end-products are to one another in the total nitrogen excreted over a given period, and how these quantities compare with a similar computation of the blood.

The nitrogen distribution in a normal person's excretions, with even a variable food supply, remains remarkably constant over long periods, and ultimately, either through disease or simple wear, one or other of the body functions commences to fail. If this impairment of function be detected in its earliest stages dietetic adjustments may be adopted with advantage, and commencing disease averted. After all, the principles involved are only a special case of those commonly employed in engineering, industrial chemistry, metallurgy, and many other industries. Why not apply them to medicine? The knowledge and the laboratory facilities exist—all that is required is real cooperation between those who work at the bedside and those who work in the laboratory.

Army Rations.

By SIR WILFRED BEVERIDGE, K.B.E., C.B., D.S.O., M.B., D.P.H.

Late Director of Hygiene, War Office; late Professor of Hygiene, Royal Army Medical College, etc.

OWING to the varying conditions of a soldier's life and service in many parts of the world, in addition to the specialized nature of the work required of him, the provision of a universal diet to suit all his needs is obviously impossible. The soldier's dietary has to be considered and constructed, therefore, in accordance with those particular requirements, and so not one but many special rations have to be provided.

Such diets or rations comprise the following: The normal peace ration; the field-service ration, which is further subdivided into the front-line ration, and that for the lines of communication, both varying materially with the exigency of a campaign; the standard emergency ration, one or more of which are carried by the soldier under active service conditions, and for use only in extreme necessity as may be decided by the general officer commanding; the haversack ration, which generally consists of bread and cheese, carried on field exercise; rations for rail or ship transport; and hospital dietaries. In an army in the field, in addition to these, special diets have to be arranged for native troops, women auxiliaries, labour companies, and prisoners of war, each according to their needs. Moreover, special rations are arranged for troops serving in tropical or arctic climates, both in peace and war.

Although the main principles applicable to all diets for communities are not departed from in the construction of a soldier's diet, yet the quantity and character of the food required especially depends upon

the amount and nature of the energy expenditure, the amount of body heat necessary to counteract extra exposure, and the age and weight of the men. Stress is laid on the fact that the recruit, still more or less a growing lad and undergoing a course of physical training to which he is unaccustomed, requires more food than the trained adult soldier.

During the period of the war the Inter-Allied Scientific Food Commission, recognizing this fact, recommended that young recruits should receive extra food representing an energy value of 200 calories per head per day in addition to the ordinary army ration. The Food (War) Committee of the Royal Society, relying upon direct measurements of the expenditure of energy by recruits undergoing training for war, recommended that the recruit of average size should receive a diet representing not less than 3,750 calories per day.

In the construction of army diets, except for recruits, any qualification to meet the needs of size and weight can only be permitted to a very limited extent. It would be impracticable to provide a series of diets to meet the variations from the average of all the different arms of the service, and so an average normal ration is provided which, in practice, has met all requirements. In special cases, however, some increase in the diet for men of greater size than the average, and engaged in intensive labour, is called for. During the war, for example, men engaged in quarrying and in lumber felling received an increased diet amounting to well over 5,000 calories per man per day. The energy expenditure of the soldier in relation to his food was fully investigated by Cathcart and Orr in 1918. These observers determined by direct calorimetry the energy expended during all the phases of a soldier's daily life, and stated that the soldier in training for war must be supplied not only with ample food, but must have body reserves in the form of fat and other

material so as to maintain his efficiency when compelled by exigencies of service to lose touch with his source of supply.

It is now customary, when framing a soldier's diet, to take into consideration, in the first place, the energy expenditure under the different conditions of service, including that due to the weight of the load to be carried, and the probable nature of the anticipated warfare, whether mobile or stationary. The energy expenditure is determined by the direct method of Douglas and Haldane, since this method is particularly adapted to mobile subjects. The energy expenditure of the soldier at the present time under peace conditions amounts to approximately 3,380 calories per man per day, and since the food must contain more energy than the man is expending, the present army peace ration has been fixed at 3,600 calories per day. Experience has shown that the men do well on this daily allowance and gain weight.

Cathcart, Richardson, and Campbell have shown very definitely that a load equal to one-third of the body-weight is the maximum which a soldier should carry. Since the average body-weight in our army is about 135 pounds, this would mean that the maximum weight of clothing and equipment to be carried by the soldier should not exceed 45 pounds. In France during the war the men were required to carry a load of approximately 80 pounds in weight, and in the winter, when the clothing and equipments were wet and muddy, a weight of over 100 pounds was not infrequent. The load carried and the method of adjustment have considerable bearing on the energy expended, and hence on the food requirements. If the load is excessive or ill-balanced the value of the normal dietary may be influenced considerably.

Variety, so essential in all dietaries, is often difficult to obtain in the field, and can only be given as was done

in France, by the substitution of certain constituents of the diet by others in equal proportion, having regard to their food value—for example, mutton or preserved meat for beef or fruit in lieu of vegetables. Variety was then often more or less compulsory (and would be again, when shortage of certain foodstuffs from economic difficulties occurred), and substitutes had to be found.

In peace, variety in the ration is obtained by allowing a certain amount of commutation of some of the constituents of the normal ration, the kind and amount being laid down by the War Office, and also by making use of daily menus prepared by all units based on a monthly menu issued by the Supply Branch of the army. Variety and also economy have followed the improvement in army cooking, which has made great progress since the war. Climatic conditions call for appropriate modification of the rations as regards protein and carbohydrate requirements. Diets can, with advantage, be reduced during the summer, even in temperate climates, thus tending to economy. Food supplied for active service in the field must be portable, with good keeping properties, and as far as possible should conform to that which the bulk of the men are accustomed, hence bread, meat, and bacon form the staple articles of the ration. Owing to the increased wear and tear, loss of sleep, exposure, continued mental strain, and extra liability to contract disease, an ample ration, well-balanced in constituents, portable, varied as much as possible, easy of digestion and assimilation, and containing a due proportion of vitamin-containing foods, is essential for the needs of an army in the field. Experience has shown that a ration of this nature must afford an energy value of at least 4,000 calories per man per day, anything short of this being inadequate.

The protein requirement for men in the field has led

to much controversy, but the opinion held by all experienced military observers is in favour of a somewhat higher amount than for peace requirements. The stimulating effect of protein is of distinct value, and personally, after long experience, I have seen no ill effect whatever from quantities ranging from 120 to 140 grams per man per day. For men on the lines of communication other than for those in training camps or engaged in extra hard labour, the protein requirements need not exceed 100 grams per day, and the total caloric value of the ration as a rule need not exceed 3,350.

One of the great difficulties of catering in the field is the regular supply of the right proportion of foodstuffs containing the necessary accessory food factors. When wholemeal flour is used for bread and biscuit, and fresh meat and fresh vegetables or fruit are available and prolonged cooking is avoided, any army has little to fear from the occurrence of deficiency disease. It is, however, often impossible for the Supply Branch to maintain a regular supply of fresh vegetables in the field, although potatoes and onions are generally available. Apart from scurvy, many of the septic skin conditions and what is termed "inflammation of connective tissue," may be encouraged by a lack of vitamin-C. Dried vegetables in lieu of fresh are now prohibited in the army, and when vegetables fail recourse must be had to fruit.

Although lime juice is included in army field rations, to be issued only on the advice of a medical officer, its value has now not the same significance as formerly, since the field ration normally contains a sufficiency of accessory food factors.

During the war Dr. Harriette Chick observed, however, that the lime juice then issued had little or no antiscorbutic value; indeed, the term lime juice until the middle of the nineteenth century was used to

describe the juice of lemons. Lemon juice made from fresh lemons and which contains the pulp and a certain percentage of volatile oil from the rind is now substituted for lime juice in our army.

In the event of any deficiency disease arising, recourse can always be had to yeast extract and to germinated pulses, which on occasions have proved of the greatest value, and are easy of preparation in the field.

It must be remembered that in war, not only is deficiency disease to be guarded against, but that such conditions as war œdema, intermediary stages of fatigue, depression, headache, indigestion, and melancholia may all be associated with a lack of vitamins.

It does not appear to be generally known that alcohol forms no part of a soldier's ration, either in peace or war, and that it is only issued on special occasions on the advice of a medical officer. We are all aware that in the past war, a ration of rum on occasions was beneficial in the exceptional circumstances of life in the trenches in the winter months, when men were exposed day and night to inclement weather, fatigued beyond measure, and exposed to constant mental strain. A certain amount of alcohol, preferably given at the end of the day, is beneficial as a gastric and nerve stimulant to men under circumstances such as these, but habitual use is not justified under any circumstance of service in the field.

Food and the Public Health.

By WILLIAM J. HOWARTH, C.B.E., M.D.

Medical Officer of Health for the City of London.

IN no branch of preventive medicine has greater activity been shown in this country since the war period than in that relating to the control and supervision of the food supply. No doubt the war experience contributed materially to this end, for all will recollect the importance which the food problem assumed during that period of strife. Mere bulk of food assumed a lesser importance than character; the variety of possible substitutions was emphasized in both this country and abroad; the discoveries of unknown factors in food, the absence of which profoundly affected health and well-being, and the dependence of this country on oversea supplies, were all matters of intimate concern for every citizen in the land. Government of the people in the exceptional circumstances which developed necessitated the promulgation of such a series of food-controlling regulations as no one had ever before experienced. In co-operation with the Government the Press lent its services. The public received instruction in the reasons for this or that restriction; discourses were prepared on the scientific use of food; abstruse physiological problems were set out in simple language; and generally, it may be stated, that one of the advantages derived from this period of trial was that the people of this country became better instructed in food hygiene—using the words in their broadest sense—than at any previous period in history.

It would have been cause for wonder, therefore, if

this newly-created interest had died down after the urgency had subsided; people had been educated in the fact that the food they consumed played an important part in maintaining health, and they recognized that certain remediable defects existed. The ultimate result was the formation of a definite "public opinion," and the psychological moment was seized by successive Ministers of Health, aided by permanent officers who had passed through this war experience, to introduce and render effective numerous practical changes of an advantageous character.

The scientific conception of food requirements has undergone a marked change in the past decade or so, and although the calorific value of food substances has still an important bearing on health problems, and though probably such factors as the protein ratio cannot be disregarded, the position of these and other doctrines has been altered as fundamentals by the ever-increasing knowledge of the still obscure vitamins or food-accessory substances. This changed standpoint is of practical interest to the working man. A diet in ample amount of white bread, margarine, skimmed-milk cheese, supplemented by the sterilized meat sold in tinned form, cannot maintain that vigour and well-being which are sufficient to ensure an adequate output of labour or a satisfactory resistance to attacks of illness. The experience of the fatal epidemic of influenza with—as some consider, among whom I include myself—some relationship to the then character of the food supply, may be quoted as experience dearly bought, but which may benefit future generations. Among other striking illustrations of the relationship between food and health may be quoted the pathetic story of the Austrian babies during the war, the surrender of the beleaguered garrison at Kut, the outbreaks of beri-beri on board ship and in Eastern countries, of pellagra in America, the re-

searches on rickets and scurvy, and the indications that many of the dental troubles of to-day may be attributed to irregularities of feeding.

A brighter view is the improvement in infant mortality, a feature of the last twenty years. To what extent the reduction of dirt or of contaminating organisms has been responsible has not yet been fully demonstrated, but I think one may safely say that, notwithstanding the laudable devotion of that band of women workers who, under the auspices of progressive local authorities and numerous voluntary agencies, have applied themselves to this problem, success would not have been so pronounced had pasteurization and the commercial production of dried milk not been a concurrent association with this activity. In this connection it is of interest to note that pasteurization of milk became an increasing necessity to avoid the wastage of a valuable product which defective methods of production, distribution, and storage rendered increasingly requisite.

So much attention has been paid to disease in relation to food that there is a danger that it may be over-assessed, which thought arises when one contemplates some recent views on the causation of cancer. The actual cause and exciting factors seem in danger of being confused, but perhaps it depends on the point of view of the contributor. To one who is keenly interested in the cancer problem the temptation to elaborate the thesis is considerable.

Just as food is better regulated to-day than ever before, so is scientific inquiry into the problems more active. This activity is not limited to private laboratories, as is proved by the work of the Food Investigation Board of the Department of Scientific and Industrial Research. This Board consists of a central executive, under the able direction of Sir William Hardy, secretary of the Royal Society, and distributes

responsibilities among different committees, of which may be mentioned those dealing with canned foods, fish, frozen meat, fruit, and the like. The amount of fundamental knowledge which is being accumulated by this Board is not generally known, since a large amount of labour has necessarily been expended on matters which are not of general interest, particularly such as include complicated investigations of a chemical or physical character, and in a few instances bacteriological. The dependence of this country on imported food necessitates a full knowledge of how that food may be transported without prejudicially affecting it in any of the various possible ways, and inquiries have been instituted into the subject of frozen fish, the importation of fruit and eggs, frozen meat, the changes observed in condensed milk and tinned products, and the like. With similar aims, but in a more specialized manner, the Low Temperature Research Station, administered for the University of Cambridge by a special committee and supported by Government funds, is unique, and the reports from the research workers engaged therein are of unchallenged value to the scientist, trader, administrator, and the public, and the maintenance of health is undoubtedly one of the chief objects aimed at.

The public will have reason to be appreciative of the numerous administrative measures which have issued from the Ministry of Health in recent years. The regulations controlling imported food have been tightened up, and the procedure is now, on the whole, clear cut, with the sound objective that only food which is fit for human consumption shall enter this country, and so packed and transported that the huge consignments shall offer the minimum of difficulty of inspection on arrival. International arrangements are entered into, and the system of supervision at the place of origin requires to be approved before certain products

which present difficulties in the way of later supervision are allowed to be admitted accompanied by the approved official certificate.

Standards of composition for varieties of dried milk and condensed milk have been established, and although regulations still allow of the sale of skimmed milk products, these clearly require that the tins containing such milk should be marked "Unfit for Babies." The date of manufacture of tinned food is also not yet a compulsory announcement.

Improvement in the milk supply has received an impetus from the "Designated Milks" Order, which seems to establish the principle that milk produced under certain specified conditions shall receive the advantage of an official designation. Seeing that the standard of excellence receives approval, it is not a far step to require that a milk which does not reach a reasonable minimum in standard shall receive correspondingly definite official disapproval. The new order has stimulated local effort, and doubtless the day is not far distant when a minimum standard of suitability will be created. The present position with respect to "Pasteurized Milk" is unsatisfactory, since the use of the words is strictly limited to milk treated under approved conditions. The position ought to be that disclosure should be required whenever milk has been so treated by heat, but that the treatment should be limited to approved methods. At present anyone can sell heated milk without control and without declaration—an obviously unsatisfactory condition.

Departmental committees have been set up and have reported on both meat control and preservatives in food. In each instance regulations were framed with commendable promptitude bearing on the subject and in accordance with the committee's recommendations. Meat inspection, handling, and marking, have been placed on a better footing, and additional supervision

of slaughterhouses has been arranged by bringing under control those existing in rural areas.

The prohibition of the addition of preservatives to food has been decided upon and will shortly be operative. The delay of a year or two has been necessary to avoid a dislocation of trade. The limited number of foods to which preservatives may be added is now stated, as well as the particular preservative and the maximum amount. This measure will do much to clarify a situation which has been full of doubt and a source of irritation to all concerned.

Public health has received protection in other directions; for example, new powers exist which are intended to lessen the risk of milk infection by tuberculous employees; the powers to control places in which food is prepared as contained in the London County Council (General Powers) Act, 1908, have been extended to the provinces by the Public Health Act, 1925, with one or two important supplementary clauses. The notification of cases of food poisoning has been approved in the City of Edinburgh, an administrative measure which seemed sooner or later sure to follow the interest which has been displayed in this subject in recent years. Finally, one may refer to the increasing part which the members of the veterinary profession are playing in preventive medicine. The new Diploma in Veterinary State Medicine, and the development of research in comparative anatomy, are subjects which will prove of future benefit to the community.

This brief summary of recent advances surely indicates that the reproach against public health work in the matter of food hygiene will soon lack justification if that position has not already been reached. Post-war progress has been so considerable that an enormous leeway has been made up in a comparatively brief period of time.

Diet in Public Schools.

By L. R. LEMPRIÈRE, O.B.E., B.A., M.B., Ch.B.
President of the Medical Officers of Schools Association.

THE health of the adolescent is unquestionably of prime importance, and it is universally agreed that the individual can be made or marred by the conditions of his or her earlier years, and in these conditions diet takes a foremost place. There is no other subject upon which so many feel entitled to air their views, and upon which opinions differ so much. So diverse are the views that the only dietetic articles condemned by nobody appear to be water and the orange! However, no one can possibly ignore or fail to appreciate the immense value of the discoveries made and the work done in this connection by Sir F. Gowland Hopkins, Dr. Plimmer, Dr. Hamill, and other eminent workers, and it may be of interest to review in some measure an average public school diet of the present day in the light of modern discoveries.

Of school medical officers, the late Dr. Dukes, of Rugby, the bulk of whose views hold good to-day, years ago laid the foundation of school diet, and much good work has been done more recently by Dr. Friend, medical officer of Christ's Hospital, to whom the writer is indebted.

It must be remembered that diet is not an end, but a means to an end. What, then, is the criterion of a good school diet? It postulates not merely the absence of illness, but a steady level of good health, with a more or less regular growth and rise in weight.

Good health is affected in several ways, the chief of which are diet, exercise, sleep, and environment, and it is obvious that the difficulties of assessing a right value to any one of these factors is great, and par-

ticularly so in the case of diet.

Public school diet presents the same problems and difficulties as in the larger world, accentuated for two main reasons: That it deals entirely with (1) a very active and constantly changing individual; (2) mass conditions, where all must feed alike. Theoretically, the school medical officer is the best judge of an efficient diet, and he should have a large control in this subject, but of ten whole-time medical officers five have only a partial control, and three none. This is the first weak spot in school dietetics. As this article does not aim at being a scientific exposition, but is rather the practical experience and observations of the writer with over twenty years' intimate experience of public school life, reinforced by the facts and opinions given by a considerable number of other school medical officers with similar experience, it would be as well to present some of the facts obtained, and see how far they comply with modern requirements and secure the object aimed at, the good health and growth of the individual. Subjoined is a sample food value table at one school:

	Oz. per week.	Calories.
Bread	100	7,700
Oatmeal	3	318
Flour	8	816
Sugar	16	1,808
Butter	8	892
Milk	90	1,800
Meat	71	1,615
Bacon and Pork	11	1,820
Sausages	6	636
Pork Pies	2	130
Corned Beef	3	195
Fish	14	308
Soup	30	
Eggs	4	252
Cheese	3⅓	347
Potatoes	80	2,000
Greens	10	90
Jam and Preserved Fruit	15	1,050
Fresh Fruit	4	44

Total Calories: per week, 24,851: per day, 3,550.

Compared with a similar table of thirty years ago this represents an increase of nearly 700 calories, and from that point of view is a generous diet, although none too generous in practice, considering the rapid growth and enormous activity displayed.

There are certain definite weak spots: for instance, the small allowance of the fatty foods, butter and milk, also of green vegetables, the absence of stone-ground flour, and the very poor allowance of fresh fruit; the first deficiency is usually made good by the supply of cod-liver oil from the medical officer, the latter by the purchase of fresh fruit by the boys themselves, which they will always buy if they can.

The proteids and carbohydrates are ample, and these could be curtailed with advantage if the other deficiencies were made good, so as to secure a more nutritious and balanced diet.

The answers to the questionnaire sent to twelve large public schools for boys and four for girls are tabulated overleaf, with one industrial school return for comparison, and an analysis of some of them is not without practical interest. The numbers, though small, are quite typical and representative. Practically all are agreed that the feeding is much better than twenty years ago. The old bread-and-butter tea has been in general supplemented by an extra dish which was undoubtedly wanted; in one school this addition has entirely eliminated the hams, tongues, chickens, etc., previously supplied from home which filled two large meat safes. Although originally confined to vegetarian dishes, they have been in part replaced by meat ones, with no apparent physical or moral harm. This implies meat twice a day at least, which is none too much. Years ago meat at the evening meal was supposed to arouse the "animal passions," but school morals have improved in spite of the introduction of this meal.

In many schools a similar deficiency of fats, green

Public Schools.	Time Allowance for Meals (compulsory).	Extra Dish at Tea.	Vegetarian Dishes.	Optional Meals (% Attendance good?)	Fresh Fruit.
Boys. 1	Breakfast, 25m. Dinner, 30m. Tea, 25m.	Yes. Meat.	Sometimes. Baked beans popular	Supper. 60-70 %	Oranges occasionally. Always in sanatorium.
2	Breakfast, 30m. Dinner, 35m. Tea, 30m.	No.	No.	Two biscuits at supper. No.	Once a week
3	Breakfast, 30m. Dinner, 30m. Tea, 30m.	Yes.	Yes. Are liked if well made.	Afternoon tea in summer. Milk and biscuits at bedtime.	Not as a rule, sometimes [illegible] on Sundays.
4	Breakfast, 30m. Dinner, 40m. Tea, 30m.	For senior boys only	No.	Light supper for late prep 90%.	Cooked fresh fruit when in season often. Apples, oranges, bananas occasionally.
5	Breakfast, 20m. Dinner, 30m. Tea, 25m.	Generally. Meat very occasionally	No.	No.	Very occasionally.
6	Breakfast, 30m. Dinner, 35m. Tea, 15m. Supper, 22m.	Not always. Meat sometimes.	Yes. Not very popular. Craving for meat.	No	Apples from own orchard. Other fruit occasionally
7	Breakfast, 30m. Dinner, 30m. Tea, 30m. Supper, 30m.	Yes. Meat or eggs	No.	No.	[illegible] fruit in summer
8	Breakfast, 15m. Dinner, 35m. Tea, 15m.	Eggs at times.	Salads occasionally. Not popular.	Cocoa, [illegible] a.m. Tea, [illegible]. Very popular. Supper, 8.30. Well attended	No. Boys provide their own. Always supplied in sanatorium.
9*	Breakfast, 30m. Dinner, 40m. Tea, 30m. Supper, 10m.	No.	No.	Lunch. Well attended.	No.
10	Breakfast, 30m. Dinner, 30m.	No.	No.	Cocoa 7 a.m. Badly attended.	No.
11	—	Yes. Hot dish or cold meat	No.	No.	No. But cooked in summer frequently.
12	Breakfast, 15m. Dinner, 30m. Tea, 15m.	Yes. Meat.	Yes, at tea. Some are quite popular.	Cocoa, 7 a.m. Afternoon, cocoa. Light supper.	Once a week in fruit season. Additional stewed fruits, apples daily when in season
Girls. 1*	Breakfast, 30m. Lunch, 15m. Dinner, 25m. Tea, 25m. Supper, 25m.	Yes. Meat at supper.	Yes, at supper. Popular.	No.	Daily at supper.
2*	Breakfast, 25m. Lunch, 5m. Dinner, 30m. Tea, 20m. Supper, 25m.	—	Yes, at supper. Occasionally appreciated	No.	Three or four times a week.
3*	Breakfast, 30m. Dinner, 30m. Tea (light). Supper, 30m.	Yes, at supper.	Yes, at supper. Not popular.	No.	Once a day.
Mixed boys and girls.*	Breakfast, 25m. Dinner, 30m. Tea, 30m.	Yes. Meat given.	Yes. Much appreciated	No.	Daily in winter. Sometimes twice in summer.
Industrial.*	Breakfast, 30m. Dinner, 30m. Tea, 30m.	No.	No.	No.	Once a week.

* No food allowed except at meal-times in these schools.

Daily Average Allowance.	Bread Used.	Are Private Extras Allowed ?	Are they Better Fed than Twenty Years Ago ?
Butter, $1\frac{1}{3}$ oz. Milk, $\frac{3}{4}$ pint. Bread, 13 oz. Meat, $7\frac{1}{2}$ oz.	Standard and white.	Yes, at B. and T. Jam.	Yes. Very distinct improvement in variety, amount, and service.
Butter Milk Bread Meat } *ad lib.*	White.	Yes, at T. Eggs, cake, potted and tinned meat or fish.	About the same.
Butter, 2 small pats. Milk Bread Meat } *ad lib.*	White.	Yes, only from tuck shop; not meat. Used as relishes, not as food.	Yes.
Butter, 1 oz. Milk, $\frac{3}{4}$ pint. Bread, *ad lib.* Meat, 8 oz.	Stone-ground. 80–90 %.	Yes, at T. No tinned foods.	Yes. Diet now adequate. Well cooked and served.
(?)	White.	Yes, at T. Potted meats and jam.	Very much better fed.
Butter, $1\frac{1}{3}$ oz. Milk Bread Meat } *ad lib.*	White.	Exceptionally. Usually eggs at T.	Yes.
Butter, 1 oz. Milk Bread Meat } *ad lib.*	White.	At B. and S. Potted meat, jam, sardines, cheese.	Yes.
Butter, 2 oz. Milk Bread Meat } *ad lib.*	Stone-ground, 40 %. White, 50 %.	Yes. B., anything. D., pickles. T., potted meat, jam.	Most certainly. The poorer boy is probably better fed than at home. Pocket money is unnecessary
Butter, $\frac{5}{8}$ oz. Milk, $\frac{3}{4}$ pint.	White.	Yes. B., jam. T., eggs, jam.	Probably rather better.
Butter, $1\frac{1}{4}$ oz. Milk Bread Meat } *ad lib.*	White.	D., pickles and sauce. T., tinned food, jam, force, etc.	Yes.
——	White.	Yes, at B. and T.	Much better.
Butter, $\frac{1}{2}$ oz. Margarine, $\frac{1}{2}$ oz. Milk, $\frac{1}{2}$ pint. Bread, 11 oz. Meat, 10 oz.	Stone-ground. 80 %.	B. and T. Potted meats, jam, force, etc. D., pickles.	Much better.
——	Stone-ground. Occasionally white, which is more popular.	Only at T. Birthday cakes. Sweets twice weekly.	Yes. Especially in fruit.
Butter, $1\frac{1}{4}$ oz. Milk, $\frac{3}{4}$ pint.	Stone-ground.	No.	Yes.
Butter, $1\frac{1}{4}$ oz. Milk, $\frac{3}{4}$ pint. Bread, 8 oz. Meat, 4 oz.	Stone-ground and white. A change is liked.	No.	No.
Butter, $1\frac{1}{4}$ oz. Milk, $\frac{3}{4}$ pint. Bread Meat } *ad lib.*	White and stone-ground.	No.	No change.
Margarine, 6 oz. Milk, 1 pint. Bread, 11 oz. Meat, 3 oz.	White.	No.	No.

vegetables, and particularly fresh fruit, is to be noted. In only two schools (one girls, one mixed) is there anything like an adequate supply of the latter, which is in the main made good out of the boys' private pocket.

It is a matter of much regret that stone-ground flour, which is the main source of vitamin-B, is so seldom used. Experience shows quite clearly that when tried it is soon liked, if some white flour is mixed with it and it is eaten fresh; 80 per cent. is a good average. Incidentally, the initial cost is slightly less, it goes farther, and boys do not eat so much, therefore it is economical as well as being more nutritious and more of a laxative; but it does not make good pastry. Vegetarian dishes are not popular as a whole, though some are a real success if not given too often—for example, cheese and tomatoes, braised carrots and gravy, onions and gravy.

Time of Meals.—In all cases there is an average of about five hours between the principal meals; in the winter months this is too long for some, and an optional light lunch in the morning and tea or cocoa in the afternoon should be provided, and in the summer, where early school still exists, some food should be insisted on before the first lesson. The fear of damaging a boy's digestion by calling on his gastric juices too frequently by these supplemental meals is a pure myth. In the girls' schools these supplemental meals are compulsory, and they are better fed than the boys, a complete reversal of the tables of bygone years.

The time allowance is inadequate in several instances; a minimum of twenty minutes for breakfast and tea, and thirty-five minutes for dinner, should be insisted upon; the two former meals, which, as a rule, are not so official as the mid-day one, are very liable to be curtailed and rushed.

How soon should exercise be allowed after meals?—Theoretically one hour is always insisted on by the authorities and dietetic experts; but it is hard to find

any records of illness or injury, acute or chronic, which could be put down to violation of this rule, though fives, squash racquets, gymnastics, and tennis have for many years been played within this interval. Provided runs and football are prohibited, half-an-hour's interval seems ample; it is not natural for any young animal to keep quiet after a meal.

Another vexed question is the supply of personal extras through the parents' pocket, either from home, the school tuck shop, or outside shops. In all boys' schools but one this is allowed, but in none of the girls' schools. In my opinion, supported by most of the other medical officers, very strong evidence of its deleterious effect should be brought before this time-honoured custom is abolished. It gives an enormous amount of personal pleasure; a boy values his own pot of jam far more than any provided by the school, and values the privilege of making his own tea and doing some amateur cooking, which often leads to a social interchange between master and boy, and is of real value. However, the amount and quality need closer supervision. The supply of money should be limited; far too much is allowed. An average of £2 per boy per term spent on extra food is probably no exaggeration. No extra home food should be allowed without the sanction of the house-master, and all other extras should be bought at the school tuck shop only, which should be under the management of the members of the staff, the profits reduced to a minimum, and those gained used for the benefit of the school at large. Wisely managed, the tuck shop is a valuable asset; but the uncontrolled supplies of food and pocket-money sent by so many parents are not only unnecessary, but are a very real danger and call for reform and restriction.

No food should be allowed to be eaten before any of the three chief meals, and the tuck shop should be open

only in the short morning break and after dinner.

Faddiness and Grumbling.—Almost all of us agree that boys (and girls) are very faddy, especially the younger ones, and a particular dish will be refused by many and boycotted without trial, if one or two set the example. The writer has, from time to time, insisted on small boys eating such a dish with excellent effect on the rest, the alternative being medical inspection and a probable dose of castor oil. If a dish is universally unpopular, there is some good reason for it. Most of the faddiness has been learned at home, and may in part be due to the very small families that generally obtain nowadays, with the inevitable spoiling of the only child. The born grumbler is much more rare, but generally exists as in other branches of the community, and constitutes a real danger.

Fish in bulk is very difficult to cook and serve in an appetizing way, whatever the pundits say, and is never as popular as meat. Boiled fish is condemned wholesale. Fish pies, fish cakes, kedgeree, fish fried in oil, are the best methods, and are much more appreciated if only a few tables are served at the same time. Cold fish with salad and mayonnaise dressing is excellent in summer. Fresh herrings and mackerel are most valuable breakfast and tea dishes. A hot service for fish items is imperative.

This leads to two of the vital points of school diet, cooking and service, and there is no question but that these are in practice far more likely to be at fault than the food. From this point of view, the boarding-house system of feeding fifty or sixty boys together is distinctly preferable to the hostel system of feeding five hundred. It is much more difficult to procure good attractive hot dishes for five hundred than for fifty where boilers have to be used in place of large saucepans, for example, for vegetables, and where fish and other items must necessarily be cooked in batches. A similar difficulty applies to a quick efficient

service, and good table setting, crockery, linen, etc., with its unconscious, but very real, accompaniment of reasonable decorum and good table manners. It is unfair and untrue to say that the boarding-house master waxes fat at the expense of his boys. Nothing of the sort; the same libel might apply with equal untruth to the hostel school. In each case there may be, and no doubt are, errors of ignorance, but in these days of mixed diet and large varieties of food a house-keeper or steward cannot go very far wrong with medical supervision, though in the case of the boarding-house school, the Eastbourne system of a general expert caterer to advise all the houses is worthy of extended trial. The crux of the whole matter is the cooking, and there is no more false economy from all points of view than a cheap or inefficient cook; a good cook is above rubies.

In drawing up a school dietary the following general points—very obvious ones—must be kept in mind:—

A. FROM THE BOYS' POINT OF VIEW.

(1) It must be sufficient and, indeed, generous. The 3,500 calories mentioned before is not too much. Can a boy be overfed? At home, Yes; at school, No. His natural inclination or compulsion for games, the really strenuous life he leads prevents this. Any form of indigestion is very rare, except, perhaps, the acute type following a Saturday "grub," which is quickly cured by Nature or castor oil. Normally, a healthy boy's stomach is as elastic and tolerant as his heart, and cannot be deranged. The complaint of stomach-ache almost certainly suggests the appendix; but the causal connection between appendicitis and diet is not yet proven.

Constipation, indeed, is common, and is probably affected by the preponderance of carbohydrates alluded to, and the comparative absence of fresh vegetables and fruits, though environmental conditions and previous

bad habits, so often alluded to on the medical sheet on entry, play a part. A certain number of cases of feverish chill, the bugbear of the school medical officer, may be assigned to this cause (constipation), but certainly not the bulk of them, which without any doubt arise in the upper respiratory tract and are so clearly influenced by atmospheric conditions.

It is stated that resistance to disease and infection is much lowered by wrong diet: this may be true in the poorer classes, but there is no evidence of it in the public school. The exanthemata come and go. Influenza comes like a bolt from the blue, but no connection with diet can be traced.

(2) It must be nutritious, and supply the necessary vitamins. Of these by far the most likely to be deficient is vitamin-A, though theoretically there is a bigger deficiency in both vitamins-B (where stone-ground bread is not eaten) and C, the latter being made good out of the boys' pocket.

The most trustworthy guide to a nutritious diet is weight, and there is no better test of good progress than rise of weight plus good health. Every boy up to the age of sixteen should increase in weight during term; after that age this is not nearly so important. The rate of increase varies in different boys, but each boy has his own normal rate, worked out by Mr. Hawkins, of Haileybury, many years ago as the result of a large number of observations on public school boys, and published in the form of graphs, which are of the utmost value in assessing any given boy's progress. Weights should be taken at least twice a term, better three times. It will be found that loss of weight or diminished increase during term time is due to: (a) coming back too fat—a common cause; (b) illness; (c) fatigue (the result of over-exercise, or insufficient sleep), more often than to dietetic errors.

(3) It must be palatable. Boys will not eat what

they do not like because it is good for them, and until we adopt Prussian methods, they will continue to exercise their choice. They tire even of their favourite dishes, and variety and absence of routine, insisted on by all, is of the utmost importance. It is better to serve at times a less nutritious dish and mar the food balance than insist on a too rigid observance of the dietetic laws. A boy's appetite in the main is a very good judge, and what he enjoys is more likely to be assimilated.

B. FROM THE SCHOOL POINT OF VIEW.

(1) It must be easily cooked and served. This has been alluded to above. In these days of universal domestic difficulties, the problem is more acute in public schools than elsewhere, and school diet is unquestionably affected by the generally poor type of girl that drifts into (and out of) the school kitchen; this applies more particularly to the provision of extra dishes at breakfast and tea in the hostel schools.

(2) It must be economical. From a practical point of view, this must be faced. Here, of course, the hostel school is at a great advantage compared with the boarding-house. But in no school have the fees gone up anything like commensurate with the cost of living, and many schools must be hard put to it to make both ends meet. School fees in the list on pp. 196–197 vary from £130 to £270 a year, and the diet is bound to vary too. The surprising thing is that such a liberal diet should in general be applied. Variety is excellent, but to vary oatmeal with rolled oats, grape nuts, etc., costs 100 per cent. more. Half an ounce extra of butter a day costs £300 a year in a school of 500; an apple a day, £600; an extra dish at tea, £1,250.

Staple meat dishes must remain—legs and shoulders of mutton and large rounds of beef, at least amongst the schools with lower fees. Made-up dishes, stews,

hot-pot, cottage pies, rissoles, still must, and do, appear on every one of the school diet-sheets. That the public school diet of the present date is on the whole good, and meets reasonable requirements, in spite of the numerous letters and criticisms which appeared in the newspapers a few years ago, is supported by the fact that the bulk of school medical officers agree that while the physique of the boy now entering school life is less good than his predecessor of twenty years ago, the large majority of the weedy delicate boys improve in health enormously during their school life.

CONCLUSIONS.

The main points may be summed up as follows :—

(1) The school medical officer should have a large control in the dietary.

(2) Public school feeding has much improved in the last twenty years.

(3) The allowance of butter should be not less than $1\frac{1}{2}$ oz. per day, and of milk $\frac{3}{4}$ of a pint. Fresh fruit should be provided every day, and stone-ground flour (80 per cent.) made compulsory.

(4) The cooking and service are much more often at fault than the diet, and this is more true of the hostel than the boarding-house school, and more true of boys' than girls' schools.

(5) While extra private food should be allowed, its purchase should be confined to the school tuck shop, which should only be open at stated periods, and the amount of pocket-money should be restricted.

(6) Illness due to overeating is very uncommon, and dyspepsia practically unknown; but constipation is common, and this is the most serious fault that can be laid to the diet sheet.

(7) Meat can be eaten with impunity and benefit twice a day.

(8) Moderate exercise at an interval of half an hour after meals is not harmful.

Dietetics in Institutions for Children and Young People.

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I USE the word "institutions" in my title to signify those residential schools and places of training for children which are maintained wholly or to a large extent by public funds or by voluntary subscriptions—in other words schools where the expenditure in connection with the dietary must be the minimum which will ensure an adequate food supply. It is important to recognize at the outset that a considerable proportion—in some cases a very high proportion—of children who come under institutional care have spent their earlier years under adverse conditions and may also rank amongst the less fortunate in their physical inheritance. If these children are to gain the maximum benefit from their life and training in the school we must be able to rely on the dietary to play no small part in restoring their impaired health and in making good their arrears of growth.

Plainly, then, the problem of successful feeding in institutions has difficulties not encountered to anything like a corresponding extent in secondary or public schools, since in the latter the dietary is generally required to maintain, rather than to establish, proper standards of health and growth, and at the same time the need for economy is not so pressing. I shall therefore try to mention here some of the main considerations which bear on these difficulties and the chief defects

which are apt to arise out of them.

To be successful in promoting healthy growth, it is essential that the dietary in an institution shall meet as nearly as possible the daily needs of each individual child, both in the quantity and nature of the food which it supplies. These individual needs of course vary considerably, and are affected by such factors as age, season of the year, and the child's routine for the time being. Judged by such a standard, and setting apart as far as possible the influence of all matters other than the food supply, the measure of success attained by the dietary from one institution to another is variable. The explanation of such differences may of course be found in variations in the total caloric value of the food supplied per child from the respective school kitchens; but inferior results are, perhaps, quite as likely to be due to defects in the balance of the dietary, to lack of variety in the catering and methods of cooking, or to the faulty service and arrangement of meals.

Catering.—On the efficiency with which the school catering is done depends to a large extent both the variety provided by the dietary and its cost. The arrangements made for the buying of food should enable ruling prices to be followed as closely as possible so that purchases are made to the best advantage, and opportunities can be seized of obtaining reasonably food which cannot otherwise be provided. It must be admitted, however, that really good buying is no simple matter, especially in smaller institutions where the purchase of food is only one of many duties falling on the officer concerned and where the situation of the school—often in the heart of the country—may compel a certain reliance on "standing orders."

Variety is a matter which only too often receives nothing like sufficient attention in school catering. It is obvious that the more varied the nature of the food supplied the better the chance of meeting the individual

needs of the group of children and adolescents comprising the average school. Hence the need for including in the dietary a wide range of foodstuffs.

Bearing in mind the great disparity in opportunities for relaxation and for change of scene, food and outlook, which exists between the holidays of children in institutions and those of boys and girls in ordinary life, special care should be taken to make the fare especially attractive and varied during the holiday periods.

The Dietary Scheme.—The dietary scheme, which determines the dishes provided and their composition, must be varied and capable of ready adaptation to meet summer as well as winter conditions. It should never consist of a rota of meals on which the same breakfast, dinner, and tea appear in an endless sequence on the same day of each week. Excepting when some special treat is known to be in store, the less children know beforehand about their meals the better, and any rota should preferably cover at least three weeks.

Whatever form the dietary scheme takes, it will be found useful if the housekeeper and cook have at hand simple data from which they can readily determine the amounts of ingredients necessary to produce any given dish in proper quantities for varying numbers of children. Unless this is done mistakes are apt to be made, and there is sometimes a tendency to keep to amounts calculated originally on a basis say of 100 boys, after the numbers have risen or fallen materially.

It is desirable that no breakfast or tea meal should consist only of bread and margarine or dripping, with a drink of cocoa or tea. Either porridge, jam, syrup, or some meat or fish food should also be given. At tea a little cheese occasionally is relished, and a good deal of use should be made of salads, which are most valuable adjuncts to the dietary.

For institutions with an average age around fourteen years, a total value of approximately 3,000 calories

should be aimed at. When the average age is above this I agree with Dr. Friend who, writing of public schoolboys in a paper giving a number of helpful views on school feeding, advocates a daily allowance in the neighbourhood of 3,200 calories in such a case.[1]

The effect of climate and any special demands on energy made by the school training must also be allowed for in placing the total caloric value. Nautical and other schools in exposed situations may be found to need a decidedly higher total value than the average.

Whatever caloric value be regarded as sufficient the dietary scheme should give latitude in the total supplied to each child. The quantities of most foods allowed must necessarily be fixed within certain limits, but I advocate very strongly that both potatoes and bread spread with margarine or dripping should be supplied *ad libitum.*

Where three square meals are given there should, in general, be no need to add "lunches" in the middle of the morning or afternoon. Breakfast should be the first event of importance in the school day, and the work done before it limited for the bulk of the children to a short spell of light domestic work. When any of the older boys and girls have duties which occupy them for more than an hour after rising, or are allowed to stay up much later than the rest of the school, small amounts of food may be given as soon as they have dressed or some little time before they retire.

Serving.—Many a meal which leaves the kitchen hot and appetizing loses much of its value through defects of one kind or another in the service. The main object is to see that the individual needs of the children are satisfied so far as the menu allows. Younger ones should be helped first, and ample time set apart for the meal, so as to encourage good mastication and avoid any necessity or excuse for bolting.

The serving out at dinner is usually done either by

members of the staff from side tables, or by senior children or monitors, each of whom is responsible for the serving at his own table. Whenever the age of the children allows, I have a decided preference for the second method, which, with tactful supervision, gives very satisfactory results in many schools.

The size of helpings should be kept within the amount which each child is likely to eat, so that second helpings are the rule. The practice of serving out the total available amount of a dish into equal portions, without regard to children's age or size, has only to be mentioned to be condemned. Other not uncommon mistakes are the serving out of the first course—in bad cases the second as well—before any of the children are allowed to enter the dining-room; and the giving of a second helping to one section of the school only on any given day. At breakfast and tea the serving is comparatively simple. In addition to any extras provided children should be able to help themselves at will from platters kept well supplied with bread and margarine or dripping.

I believe it is unwise to attempt to limit the water drunk at dinner, or to allow drinking only at the end of a meal, and consider that a supply of water and drinking vessels for each child should always appear at the mid-day meal. Indeed, children should have free access to drinking water throughout the day.

The dining hall and its appurtenances must, of course, be scrupulously clean and as cheerful and attractive to the eye as possible. Small tables seating six to a dozen children are to be preferred to the use of a few long tables, and chairs to backless forms. The heights of tables and chairs should be such that all children can sit properly. Considerations of economy ought not to prevent the use of tablecloths, and by encouraging competition between table and table in the way the cloths are kept, a good deal can be done to train children to mannerly behaviour at meals. Salt-

cellars should be laid at dinner, and pepper—preferably black—may be allowed as well, at any rate to older children. Some of these may seem such obvious matters as to be hardly worth mention; the frequency with which they are apt to be neglected must be my justification for including them.

Common Faults of Balance.—Generally speaking, I think it is true to say that the main defects of balance in institutional dietaries arise more or less directly out of some economy which leads to a too extensive use of cheap staple foods such as the cereals, and which restricts unduly the amounts of milk, fats, fresh vegetables and fruit, and perhaps also of meat and fish. A shortage of these foods may—quite apart from any adverse influence which an excess of carbohydrates exerts through interference with the proper action of the vitamin-A and calcium of the diet—lead to lack of balance in various directions:—

(1) Either the total amount of protein supplied may be insufficient, or its nature may be such that it is incapable of yielding amino-acids in the requisite amounts and proportions. Proteins of high biological value, such as those contained in milk, meat and fish, must therefore be adequately represented.

(2) The dietary may be deficient in fats, especially in the milk fat and dripping which must supply much of the vitamin-A required.

(3) There may be a deficiency in mineral salts, particularly those of calcium and potassium. The bulk of the supply of these salts in the institutional dietary is contained in milk, green vegetables, and fruits such as oranges. Much useful information concerning the mineral requirements of children will be found in a paper by Dr. J. B. Orr.[2]

(4) The margin of safety as regards vitamins-A and C is apt to be narrow. It has been said with truth that, given an adequate mixed dietary sufficient in

caloric value, the vitamins can safely be left to look after themselves. But the qualifications involved in this statement are not lightly to be dismissed where dietaries in institutions are concerned. This is an aspect of the institutional dietary which I have discussed at some length elsewhere.[3] Efforts to secure a proper vitamin supply have the happy result of helping to safeguard the dietary so far as its mineral content and acid base balance are concerned, both of which are quite likely to be at fault if the vitamin content is low.

(5) The acid base balance may err on the side of acidity. This is liable to occur in a diet composed largely of cereals. The dietary should have a slight but definite positive base balance, and it will rest largely with the milk, vegetables, and fruit given to secure this. Valuable data bearing on this matter are given in the paper by Dr. Orr already referred to.

(6) Lack of balance is sometimes found where a dietary has grown up more or less empirically and where one class of food may bulk too largely. An instance of this is the undue reliance often placed on the dried pulses as a source of protein and as a presumed substitute for fresh vegetables.

It will be evident that an adequate milk supply is of paramount importance in the dietary of any institution for children. Whole milk should, of course, be given. Skimming, and the removal of the top-milk before issue, are dietetic crimes of the first magnitude which should not be tolerated.

A growing conviction of the desirability of a supply of milk considerably in excess of that often allowed leads me to hesitate to offer any opinion as to the minimum necessary. I can only say that I have been satisfied with the health and growth in schools where the amount given approximated to five pints per child per week.

If bread properly spread with margarine or dripping is allowed *ad lib.* at breakfast and tea, there should be

no fear of a shortage of fat. Butter can but seldom be given, and whilst readily conceding that its use in the school dietary is excellent as providing a luxus supply of vitamin-A, I believe that a satisfactory standard of health and growth can be secured without it, and so should find it difficult to justify, where children in institutions are concerned, the considerable expense involved by the provision of butter as a routine measure.

The school's supply of green and other vegetables should be as constant as possible. They should, I think, be served—apart from vegetables used in stews, etc.—not less than four times weekly, including greens twice at least. There is sometimes a tendency to rely too much on the onion, which, though an estimable vegetable, should not figure too largely or too often in the menu. In winter, and at any time when the vegetable supply falls off, oranges and apples both prove valuable supplements deserving of extensive use. Other fruits should be given in season as often as circumstances permit.

Defects in Cooking.—These may be due to some limitation in the kitchen equipment provided, such as lack of an oven for roasting. Stewed or boiled food should not be allowed to preponderate in the dietary. There is sometimes a tendency towards over-cooking in institutions, and this may become important where vegetables and other vitamin-containing foods are concerned, especially when they are cooked at high temperatures in autoclaves. The latter require very careful use. Whilst the steaming of cabbages and other greens is no doubt good so far as the conservation of potassium and other salts goes, it tends to leave the greens too strong in taste for children to eat them readily, and the better plan is, I think, to boil them in slightly salted water for just so long as is necessary to ensure proper cooking. In the case of potatoes there is,

again on the score of conservation of potash, some argument for cooking them in their skins, but this leads to considerable waste of the protein layer in subsequent peeling. Mechanical peelers, which remove merely the outer corky skin, prove satisfactory in use, and obviate the waste and labour involved in hand peeling.

CONCLUSION.

A really well-balanced dietary has an important effect on the number and severity of the children's ailments. The amount of minor sepsis and of sores of the impetiginous variety should be small. Whilst some children seem to get chilblains in winter, whatever precautions are taken, these are very much in the minority, and the appearance of an undue number of chilblains should occasion scrutiny of the dietary as well as of the school routine—there may be some shortage of milk or of fats. Careful and regular measurements of height and weight should be recorded —preferably, I think, quarterly—so as to allow the physical progress of each child to be followed closely from the time of admission onwards. Efforts should always be made to find the explanation for lack of progress. There will, of course, be some children who will fail to improve even under the best school conditions, and whose primary need is for medical care and observation, so that any bar to proper progress may be discovered and, if possible, removed.

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The Criteria of an Efficient Diet.

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THE following is but a brief personal appraisement of the bearing of modern experimental studies upon dietetics.

It is true that, nowadays, not only ordinary individuals, but the most self-confident of bon-viveurs, the most self-denying of ascetics, and even the most virulent of food-faddists will occasionally lose faith in their practice and consult a medical man concerning their diet. They look, however, for advice based upon experience of the human body more specialized than their own, and would be disturbed, and probably sceptical, if told that it was based even remotely upon, say, the experimental feeding of animals, or upon experiments made in a calorimeter. Not long ago, and perhaps even to-day, the practitioner consulted might more or less sympathize with that state of mind. "Better sound empiricism than imperfect science." "Mis-interpreted science has encouraged food-faddists more than any teachings based on experience and common sense." There is much to be said for the attitude thus suggested. But the practitioner will admit that when he is asked for advice concerning dietaries, something more is usually expected, a greater precision in detail, for instance, than he is able to give with real assurance. It is well, therefore, that he should take stock from time to time of current academic knowledge, to see whether it has anything to offer which may add to that assurance. In such matters even a little increase in definite knowledge is important.

It is generally known that evidence has recently arisen from scientific experiments, and from observations inspired by them, to show that the previously accepted criteria of an efficient diet must be somewhat modified and extended. It has become clear that hitherto the importance of detail has been underestimated; that what natural foods contain in very small amount, may be, though for different reasons, as essential as what they contain in much larger amounts. In what follows some attempt is made to appraise very briefly the actual, practical importance (as distinct from the unmistakable academic interest) of the newly-won facts.

Scientific methods yielding significant results have been applied to the study of nutrition for about three-quarters of a century. The first third of this period was occupied by the gradual development of methods for chemical studies, which at first, owing to lack of detailed knowledge concerning the constitution of the foodstuffs, were of somewhat superficial character. Some exact conceptions however—for example, that of nitrogen equilibrium as an indicator of efficient nutrition—quickly replaced the previous vagueness of the field. Meanwhile by 1870 quite accurate knowledge concerning the rate of combustion of the foodstuffs in the bodies of normal and abnormal individuals had been won by quantitative studies of the respiratory exchange. Studies of the latter kind continued with increasing accuracy throughout the last quarter of the last century, culminating in the remarkable work upon human calorimetry for which American investigators deserve so much credit. Perhaps the most striking feature of these investigations is the exact agreement between the data obtained for the energy expenditure of the body on the one hand as calculated, on purely chemical and physical lines, from the respiratory exchange, and on the other hand as measured by direct

observation of the heat given out by the body. This agreement gives proof (for those who ask for proof) that the law of the conservation of energy holds in the body. It further assures us that we may know by experiment exactly how much of each of the energy-yielding foods is required to maintain an individual in the condition of nutrition present when we study him. It does not tell us directly whether that condition is normal and desirable, or otherwise.

At the close of the last century, and for a few subsequent years, the results of calorimetry dominated the scientific outlook upon nutritional phenomena. This is not to be wondered at. The accuracy of the results made them fascinating. It is greater than biological studies can often attain to. Moreover, the fact that the broad results obtained seemed to provide a criteria for efficiency in nutrition, without the necessity of considering elusive details, gave an appearance of finality to calorimetric studies. Yet the outlook of fifteen years ago has proved too narrow, for the very reason that it tended to ignore the chemical details of nutrition.

Calorimetric data are, of course, in no sense misleading, if their limitations are kept in mind. The energy content of a food supply must always be of fundamental importance as one criterion of its efficiency. It has only to be remembered that other criteria based upon the specific chemical needs of the body are of equal importance. The law of the conservation of energy is observed by the body whether its condition be normal or abnormal, but the body is so constituted that while duly extracting energy from a sufficiency of food, it may as an organized chemical system be itself undergoing disintegration.

Even those who fifteen years ago thought about metabolism too exclusively from the standpoint of thermo-dynamics, could not wholly ignore the importance of chemical details. They were fain to recognize,

for example, that an efficient supply of minerals is required for nutrition, and, of course, that no amount of fat or carbohydrate could replace a certain minimum of protein in the diet. The view was rather that all details were relatively unimportant so long as the needs for energy were met. We now know that certain quite specific chemical items in the food are of a prime importance, though they contribute nothing of significance to the energy supply.

These highly-specific needs of the body are illustrated by a call for particular characters in the protein it receives and for a balanced mineral supply. They are shown more strikingly, however, by its complete inability to dispense with those elusive constituents of a complete dietary, which we now know as vitamins. All such demands are made in particular by the young and growing organism.

The question of specificity in the protein supply must be discussed quite briefly. In the past many endeavours have been made to determine what is the optimal protein supply, and what the safe minimum. Till recently these endeavours were made without the knowledge of the fact that individual proteins have different nutrient values. These differences arise from the circumstance that the constituent units (the amino acids) from which the complex protein molecules are built up—occur in relative proportions which may differ widely in diverse proteins. From this circumstance and from the proven fact that the body has a quite specific and urgent need for a minimal supply of some of these units individually —since it cannot make them for itself—it follows that different proteins must, as nutrients, have different values. The building up of human tissue proteins during growth requires a certain harmonious balance among the amino acids employed. If we think in terms of some one of these substances of which a daily minimum is an urgent necessity, and especially

of one which no diet-protein contains in excess, it becomes clear that to supply that minimum more must be eaten of a protein relatively deficient in this particular amino acid than of one which contains relatively more. Circumstances, indeed, may make its content of one particular amino acid the factor which limits the value (except as a source of energy) of the protein as a whole.

Many other considerations arise in relation with such facts, but the subject cannot be further pursued. The conclusions involved are real, and of more than academic significance. Their practical importance must not, on the other hand, be exaggerated. It is possible, though not proven, that a community may suffer in health from the consumption of a protein of an inferior nutritive quality. Thus, reliance upon the proteins of maize, which in the sense discussed have a low "biological value," may contribute to the etiology of pellagra. If this be so, less definite conditions of malnutrition may similarly arise under other circumstances. It is true in any case that vegetable proteins often differ widely from those of animal tissues, and more of them must be consumed than of animal proteins in order to reach equal efficiency in the promotion of growth. Children put upon a strictly vegetarian diet cannot usually consume enough food to yield an optimum protein supply. Fortunately, even in vegetarian households, the growing children are usually protected by an allowance of dairy products. In general it may be said that consideration of the varying values of proteins scarcely enters the field of practical dietetics in countries where variety in foodstuffs is secured; but the possibilities involved in the facts need to be borne in mind so that exceptional conditions may be met.

The question of the mineral supply may be postponed for the moment, and attention given to the subject of the accessory dietetic factors of vitamins. It is

important just now that the ascertained knowledge concerning these until recently unrecognized constituents of food, should be viewed correctly, and a proper sense of proportion maintained in basing conclusions upon the facts.

The following statement of fact is now based upon hundreds of experimental studies carried out by observers in nearly every civilized country.

A young, growing animal, if fed continuously upon a dietary satisfying all the criteria which would have been deemed sufficient twelve years ago, containing, that is, an abundant energy supply, a right proportion of the right kind of proteins, sufficient fat and carbohydrate and a well-balanced supply of minerals, may yet cease to grow, and, after displaying characteristic symptoms of malnutrition, may quickly die. The only necessary condition for such an occurrence is that the materials supplied should first be freed from vitamins. The animal will then die, although its food is freely eaten, well digested, and fully absorbed.

It is, furthermore, a statement of proven fact when we assert that an addition to the above described dietary of material in amount equal to no more than one-tenth of one per cent. (and probably much less) of the whole food eaten will—if it be the right material—convert that dietary into one which promotes growth and maintains health. In such potent material what we now call vitamins are contained. It was, indeed, owing to such facts as those just emphasized that a recognition of the existence of vitamins became inevitable. They are contained in natural foodstuffs from which they can, by various methods, be extracted and partially isolated.

The above dogmatic, but strictly accurate, statements indicate, however, all that is available for the actual definition of vitamins. They are constituents of natural foods, characterized by the fact that they

exert a potent and indispensable influence upon metabolism, though present in strikingly small quantities. Any closer definition than this must await the arrival of further knowledge; but the reality of their existence and importance is already established. For although they have not been obtained pure, they are assuredly concrete substances with tangible properties. They can be extracted and, by suitable methods, obtained individually in highly concentrated preparations in which they display characteristic chemical properties. We know that at least four of these substances exist, each with its own indispensable function in metabolism.

This very brief survey cannot deal with the technique of vitamin research, nor even with the details concerning their distribution in foodstuffs. Its purpose is only to urge that the recognition of their existence has made it necessary to apply new criteria to dietaries and that properties of vitamins must receive attention in practical dietetics. It is, however, equally important to urge that the whole subject should be viewed in right proportion, and that theories concerning their functions should not go beyond the ascertained facts. It must be remembered that although it is sure that the absence of a single vitamin from a dietary involves specific errors in nutrition, we do not yet know how exactly any one of them exerts its normal influence in the body.

That the effects of vitamin deficiency observed in animal experiments are paralleled in the phenomena of human nutrition is proved first of all by the existence of deficiency diseases. So long as it is borne in mind that the circumstances involved in the production of a more or less variable clinical syndrome are necessarily more complicated than are the conditions secured in an animal experiment where only one factor is varied, consideration of the evidence offered by the incidence,

the symptoms, and above all, by the prevention and cure of scurvy, beri-beri, and rickets, should be convincing on this point.

In respect of the disease last mentioned recent developments in knowledge are of the highest interest.

Cod-liver oil is universally admitted to exert a marked effect both on the prevention and cure of rickets. The results of a great deal of experimental work done by divers investigators, including those derived from a very elaborate study upon infants carried out at Vienna in 1921–1922, under the auspices of the Medical Research Council and the Lister Institute, have convinced the majority of those who give thought to the matter that this property of the oil is due to its containing a special vitamin. This particular agent is found in other animal fats, but most liver oils contain it in exceptionally high concentration. The actual isolation of the vitamin by Japanese workers is claimed, though probably without full justification. Highly-concentrated preparations have, however, been made. Now, partly at least as the result of a hint obtained during the Vienna inquiry just mentioned, experiments were begun in America and continued in this country, which show that certain fats previously incapable of exerting any influence upon bone formation —or cod-liver oil artificially deprived of such power— become strongly active in this sense as the result of exposure to radiations of short wave-length. The sensitive material in such fats is cholesterol, or substances (sterols) closely allied to it. It is likely that the radiant energy produces a definite chemical change in molecules of such substances, because the active form when once produced is remarkably stable. Presumably the activated sterol is identical with the vitamin, and the latter when naturally present owes its origin to solar radiation. On the other hand, it is well proven that efficient exposure of the body itself to the sun or to

suitable artificial radiations is a powerful means of securing normal bone formation in the growing animal or child. It would seem, then, that a factor necessary for that process can be produced within the body itself, or, alternatively, can be conveyed to it in the diet. In each case it is produced under the influence of radiant energy.

Such facts are of striking interest in themselves, and they indicate that those who have believed in general hygiene as the essential preventive of rickets, and those who have attached chief importance to diet, were not so far apart as was thought. It is, of course, clear that under no conditions could such a process as that of ossification be normal unless the supply of calcium and phosphoric acid is adequate. Doubtless the specific needs of the growing body extend to the details of its mineral supply, but under practical conditions the only deficiency at all to be feared would seem to be one of calcium, and this only in the cases of the nursing mother and the growing child. Under quite exceptional circumstances a dietary may contain too little iron. A diet composed of meat, bread, and potatoes is one illustrating calcium deficiency, but the error, whenever it occurs, is easily corrected by a reasonable consumption of milk. On the other hand, milk is well known to contain only minute amounts of iron, and the deficiency may be felt by infants maintained too long at the breast, or upon an exclusive milk diet.

Actual disease, however, follows only when the qualitative errors in diet are too pronounced for their occurrence to be other than very rare in a country like our own. It is important that it should be recognized in medical practice that deficiency is relative, and that dietaries may be consumed which, while not leading to conditions recognized as definite disease, may, because of their failure in specificity rather than quantity, involve impairment of health and diminished resistance

to infection. Such cases may be rare among adults though the close observer will find them readily enough, being usually in danger, however, of ascribing the symptoms to constitutional defects. They are certainly by no means rare in children. Indeed, if the significance of these newer conceptions concerning diet is to be properly appraised it should be remembered that the younger the individual the greater the apparent need for vitamins and other food items with specific qualities.

It is surely, however, of practical importance to know that when the infant is at the breast the adequacy of its supply of vitamins depends upon the nature of its mother's diet, and that when cows' milk takes the place of human milk there is equal dependence upon the right feeding of the animal.

If, in conclusion, the whole question of qualitative errors in diet be broadly reviewed from a practical standpoint, it is fair to say that, in this country, adult individuals living at a satisfactory economic level are usually protected by their habits from specific deficiencies. When purchasing power is restricted there may be deficiencies of the kind under consideration even when the food obtained is sufficient in amount. This is notably the case in respect to animal fats and the important vitamins associated with them, but also in respect to fresh fruits or salads as a source of the antiscorbutic factor. The former omission is a question of cost; the latter is perhaps rather a matter of habit.

At all economic levels the diet of the child is more liable to errors, and the errors have a much greater significance. Yet even here it is interesting to note that the deficiencies chiefly to be feared are those of the vitamins associated with fats, and (when ignorance exists) that of the antiscorbutic factor. Against these, high-grade milk is fully protective, and when they are put out of court other possibilities seldom need consideration.

Recent Work on the Chemistry of the Vitamins.

By ARTHUR HARDEN, F.R.S.
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EVER since the discovery of the existence and importance of the vitamins efforts have been made to isolate them and ascertain their chemical nature. Failure has so far been the result, and these mysterious substances must be added to the large group of biochemical agents, comprising among its members the enzymes and most of the hormones, which, although producing the most obvious and vitally important effects in animal and vegetable organisms, have persistently defied chemical identification.

There have not been wanting alarums and excursions in the form of announcements of the isolation of this or that vitamin, but none of these products has emerged as refined gold from the critical furnace.

Vitamin-B.—Vitamin-B, the most stable towards oxidation of the four vitamins so far definitely discriminated, was the first in the field, and the story of the early attempts to isolate it is already ancient history. The gallant attempt of Funk in 1911, executed with great skill and determination by purely chemical methods, led to crystalline products of high activity, which were nitrogenous substances—one afterwards recognized as nicotinic acid—most probably simply contaminated with the active principle. Incidentally it led also to the name vitamine, which, in its slightly modified form of vitamin, appears to be finding general

acceptance. The later attempts of Moore and his colleagues (toruline), and the much more elaborate experiments of Suzuki and his co-workers in Japan—also by chemical means—were no more satisfactory than those of Funk. The active principle (oryzanine) was undoubtedly concentrated by Suzuki about five hundred times (from rice-bran), but the alleged individuality of his products has not been accepted.

More recently Seidell, in America, has made use of adsorption methods for the attempted isolation of the vitamin. Yeast extract is treated with fuller's earth, which adsorbs the vitamin, yielding an "activated solid," which can be washed with water and alcohol. This serves as a starting-point for the preparation of more highly concentrated material, the vitamin fraction being extracted by baryta, and finally obtained as a picrate, melting at 160°. To the active substance Seidell ascribes the formula $C_6H_{18}O_2N_3$. A dose of 1 mg. per day protects pigeons from polyneuritis. Several investigators have followed the lines indicated by Seidell's experiments, and have employed adsorbents. Thus Kinnersley and Peters in Oxford have used charcoal and continued the fractionation by the aid of alcohol, finally arriving at a material which is soluble in alcohol, and of which a dose of 0·34 mg. cures polyneuritic pigeons for four days. As doses of this material which protected against polyneuritis for many days did not cause increase in weight of pigeons after cure of the polyneuritic symptoms, these authors suggest that vitamin-B may consist of two factors, a suggestion which has been previously made on other grounds.

Some confirmation of this view is to be found in the work of Levene and van der Hoeven, who by the combined use of chemical methods and adsorbents have also obtained highly potent preparations, the active agent of which is precipitable by baryta and by alcohol, whereas it will be remembered that the pro-

duct of Kinnersley and Peters is soluble in alcohol. Levene and his colleagues start with a preparation made by fractionally precipitating yeast extract with alcohol (Osborne and Wakeman), and by successive precipitations with basic lead acetate and baryta, followed by adsorption by means of silica gel, extraction of the gel first with acid and then with alkali (p_H 9), and precipitation by alcohol, finally obtain a material of which 0·1 mg. per day (containing 0·015 mg. of nitrogen) is sufficient for the daily needs of a rat. According to Emmott and Peacock this dose for a rat corresponds with about 0·3 mg. for the maintenance of a pigeon, a result of the same order as that obtained by Kinnersley and Peters for the curative dose for a pigeon.

The last-named workers suggest that their product is still very complex, and that the curative dose of the pure vitamin may be of the order of 0·001 mg. per day, and Levene and van der Hoeven also regard their most active product as a complex mixture. Seidell, on the other hand, does not think that the activity of his product is due to impurities.

The exact relation between these three products is not clear, as different methods of testing have been used in each case, but it is obvious that finality in this question is still far distant.

Under these circumstances it is not easy to ascribe definite chemical properties to the vitamin. It appears, however, that it is not inactivated by the action of nitrous acid, is affected with difficulty by acids, more readily by alkalies, and is not readily oxidised.

Yeast Growth Stimulant (*Bios*).—Closely associated in yeast with vitamin-B, the bios of Wildier is considered by some investigators to be a vitamin. Too little is as yet known about the matter to warrant this conclusion, and this interesting substance is, therefore, not discussed in this article.

Vitamin-C.—The first step in the purification and concentration of the antiscorbutic vitamin was the removal of the citric acid by precipitation as calcium citrate (Harden and Zilva). As this operation could be carried out without any loss of activity, clear proof that the citric acid was not the active principle was afforded. Incidentally, the basis on which limes had been purchased for the "lime juice" of the British Navy was shown to be entirely fallacious. Further advance was only rendered possible by the recognition (Zilva) that the vitamin was very readily inactivated by oxidation by atmospheric oxygen, especially when in alkaline solution. This imposes a very serious experimental handicap, as all operations have to be conducted as far as possible in absence of oxygen. The course of purification now adopted by Zilva, to whom the work on the isolation and properties of this vitamin is chiefly due, and to whom I am indebted for some unpublished information, is to remove the sugar of the juice (invert sugar) by fermentation with yeast, and then to add basic lead acetate, which precipitates the vitamin along with other constituents of the juice. The precipitate is washed and decomposed, and the resulting solution treated with normal lead acetate, which leaves the vitamin in solution, but precipitates various other constituents of the juice. The excess of lead is removed (by magnesium sulphate), the solution precipitated by alcohol, and the filtrate reconcentrated, and again precipitated by alcohol. The final solution, when made up to the volume of the original lemon juice, has practically the same antiscorbutic power as the original juice, but instead of 9 per cent., contains only about 0·01 per cent. of solid matter, the great bulk of which is almost certainly made up of organic acids without any activity. The protective daily dose for a guinea pig or monkey (1·5 c.cm.) therefore contains only 0·15 mg. of solid

matter. A small amount of nitrogenous material is present, but there is no evidence on which to decide whether or not the vitamin itself contains nitrogen.

The solution has powerful reducing properties, but these seem to be independent of the active principle, since the reducing properties are destroyed at a different rate from the antiscorbutic principle. Diffusion experiments show that the vitamin behaves as though it had a molecular weight approximating to that of a hexose. It is soluble even in absolute alcohol and, as already mentioned, is precipitated by basic lead acetate, but not by the normal salt.

Vitamin-A.—For the attempted isolation of vitamin-A the two key observations are, firstly, that the vitamin is liable to oxidation, both by atmospheric oxygen, especially at high temperatures (Drummond, Hopkins, Zilva), and by ordinary oxidizing agents, and, secondly, that, when the fats with which it occurs are saponified, the vitamin is found in the unsaponifiable matter (Steenbock and Boutwell, 1920). The isolation of the vitamin from the unsaponifiable matter of cod-liver oil (0·8 per cent.) has been attempted simultaneously, and by very similar methods, in Japan by Takahashi and his colleagues, and in England by Drummond, Channon and Coward. The unsaponifiable matter contains about 50 per cent. of cholesterol, and when this is removed by crystallization and precipitation with digitonin, the whole of the activity remains in the residue. This confirms a previous observation (Drummond) that cholesterol is inactive. The active residue appears to be a complex mixture, in which have been found a saturated and several unsaturated alcohols, and one or more unsaturated hydrocarbons. The Japanese investigators claim to have isolated by fractional distillation under a low pressure an unsaturated alcohol, $C_{27}H_{46}O_2$, which they regard as the vitamin, and term "Biosterin." The English workers, however, are strongly

of the opinion that no definite active compound has been isolated in this way, and regard the product of the Japanese workers as a complex mixture. Such constituents as they have succeeded in isolating from the mixture left after the removal of the cholesterol have proved to be inactive. Here the matter at present rests. Both sets of investigators have concentrated the vitamin-A of cod-liver oil about one hundred times. The most active preparations are those of the Japanese workers, of which a daily dose of 0·01—0·005 mg. suffices for the needs of a growing rat.

An interesting feature which has arisen in the course of this work is that several brilliant colour reactions have been found (Drummond and Watson) which are given by the active material, the intensity of which seems to run parallel to the activity of the preparation. Whether these are actually reactions of the vitamin itself or of some closely associated substance is not yet certain, but the question is one of great importance, as a chemical test for this, or, indeed, for any vitamin, would enormously extend the possibilities of research, and is, in fact, the great desideratum in this class of work.

Vitamin-D.—The antirachitic vitamin, usually termed vitamin-D (although Funk gives this name to the yeast-growth stimulant), which has some effect in promoting growth and is essential for the proper calcification of the bones, stands in a different position from the others, as it has been found possible to obtain it artificially by the irradiation of cholesterol with ultra-violet light.

This observation may be regarded as the culmination of several distinct lines of research carried out by different investigators. On the one hand these led to the realization that McCollum's "fat-soluble" vitamin was a mixture of at least two distinct principles—the growth-promoting and anti-xerophthalmic vitamin-A, and the antirachitic and, to a minor extent,

also growth-promoting vitamin-D. These differ in their resistance to oxidation, and in their distribution in the animal and vegetable kingdoms, but both agree in passing into the unsaponifiable fraction when the fat in which they occur is hydrolysed, and in being readily separable from the cholesterol of this fraction. On the other hand, the beneficial result in rickets of exposure to ultra-violet light led to the interesting discovery, made almost simultaneously by Hess and by Steenbock in America, that many food materials, and among them fats, acquire antirachitic properties when they are exposed to ultra-violet radiation. It was then discovered, independently by several workers, that the carriers of these newly-acquired properties were the sterols of the fats, and that these substances in the purified condition acquired antirachitic properties under the same treatment (Steenbock and Black; Hess and his colleagues; Rosenheim and Webster; Drummond, Rosenheim, and Coward). This fact has now been repeatedly confirmed, and the use of irradiated cholesterol as a source of antirachitic vitamin in a diet has been adopted as a routine procedure in some laboratories.

There seems to be little doubt that the beneficial effects produced by irradiation of animals is due to the activation of cholesterol contained in the skin and other tissues. Direct experiment has shown, for example, that skin can be endowed with antirachitic properties by irradiation. Moreover, the activation of all these substances is effected by rays of the same wave length as are efficacious when used for the direct irradiation of the living animal.

Scarcely anything is known as to the nature of the change produced in the cholesterol. It is by no means of a transient kind, as samples of activated oils have preserved their activity for as long as six months. According to Drummond and his colleagues the

irradiated product also gives colour reactions which differ both from those of cholesterol itself and from those ascribed by them to vitamin-A.

Activated cholesterol has, moreover, been shown to have less adsorptive power in the ultra-violet region than the inactive material. The dihydro-derivative obtained by the reduction of cholesterol is not susceptible of activation by irradiation, and the same is true for the reduction product of the phytosterol of vegetable oils. This seems to point to the unsaturated linkage, known to exist in the cholesterol molecule, as the seat of the change produced by irradiation.

The foregoing is certainly one of the most important and far-reaching observations made on the chemistry of the vitamins, and its further development cannot fail to be of surpassing interest.

CONCLUSION.

The present position with regard to this interesting question is that the vitamins, A, B, and C, have been obtained in highly concentrated form—from 100 to 900 times more potent than in their most active natural sources. Moreover, this concentration has been effected without any very serious loss. This is notably the case with vitamin-C. There is, therefore, up to this stage, no question of the potency disappearing under the hands of the investigator, whether from inherent instability of the compound, or from the removal of adjuvants during the process of purification. There is as yet no experimental evidence in favour of Baly's interesting suggestion that vitamins are energized forms of ordinary materials, to which they revert by loss of the extra energy. The difficulties of further advance lie in the vanishingly small absolute amounts of the vitamins which are present in natural sources and in the complication of the mixture of substances with which they are associated. Neither of these should prove insuperable to modern methods of investigation.

(Owing to the continuous demand for copies of the following article, which appeared in our issue for January, 1925—now completely out of print—it has been found necessary to include it in this number, the author having brought the subject up-to-date.)

Some Practical Considerations on the Vitamin Problem in Nutrition.

By R. H. A. PLIMMER, D.Sc.

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THE *Composition of Food.*—Until a few years ago food was regarded as consisting of five essential constituents: carbohydrate, fat, protein, mineral salts, and water, which provided all the material for growth, heat, and energy. Protein was known to be essential for growth and for replacing loss by "wear and tear." The value of protein was estimated in terms of nitrogen, and one kind of protein was considered as good as another. Fat and carbohydrate were valued solely as providers of heat and energy. The need for mineral salts was recognized, iron for hæmoglobin, lime and phosphates for bone and teeth. Attention was chiefly directed to the energy requirements of the body. Calorimetry became an exact science—indeed, certain schools of physiology made it the be-all and end-all of nutrition. This obsession with calories still blinds many reputed authorities to the advances which have been made in the study of nutrition during the last fifteen years. During the war dietaries for the fighting forces, for prisoners-of-war, and for civilian populations were planned on the calorie basis. In many instances nutritional disaster followed, causing much ill-health and loss of life which would have been avoided if those responsible for devising the diets had applied the results of modern scientific work.

The failure of the pure calorie system in practice necessitated the adoption of recent discoveries, with results that were entirely beneficial.

Modern work upon food and nutrition clearly demonstrated that in addition to the above-mentioned food constituents, three quite distinct accessory food factors or vitamins must be present to make the diet satisfactory and health giving.*

For convenience, since the chemical nature of the vitamins is not known, they are called A, B, and C. There is also some evidence that other unknowns are necessary, and these have been called D, E, etc. Many people are still sceptical of the existence of vitamins because they have not yet been isolated. Those who have found it difficult to accept their existence have assigned to salts, organic and inorganic, an exalted significance in nutrition. They have, in fact, invested salts with all the properties of all the vitamins. There can, however, be no question that vitamins are not salts. The vitamins are unstable compounds destroyed by processes which have no effect upon salts. For example, tinned or dried fruits and vegetables have lost their special nutritive value, vitamin-C, and cannot prevent scurvy, although the salts contained in them are unaltered by the processes of tinning or drying. Very active preparations of each of the three vitamins have been made. The isolation of the antirachitic vitamin is reported from

* The history of the discovery and of the growth of knowledge of the vitamins is summarized in technical form in Report No. 38 of the Medical Research Committee, and in a more popular form in "Vitamins and the Choice of Food," by V. G. and R. H. A. Plimmer. Colonel Robert McCarrison, I.M.S., in "Studies in Deficiency Disease," has dealt with the pathology of lesions due to lack of vitamins and the clinical application of recent nutritional discoveries. Special studies have been made of "Scurvy, Past and Present," by Dr. Alfred F. Hess, and of "Rickets," by Professor E. Mellanby, and by Dr. Harriette Chick and others, published in the Medical Research Committee Reports, Nos. 61 and 77.

Japan. There can be as little doubt of their existence as there is of an active principle in the thyroid gland or of the insulin in the pancreas. The chemical constitution of thyroxin and of insulin has yet to be determined. It will be remembered that adrenalin was only isolated long after the activity of the suprarenal gland was discovered. The existence of enzymes, toxins, and anti-toxins is not disputed, although their chemical nature is quite unknown. In the same way the A, B, and C vitamins must be accepted as three distinct chemical entities.

The inclusion of the vitamins does not alter the calorie requirements of the body under different conditions. Calories, protein, and vitamins are all wanted. Man cannot live on calories alone.

A Balanced Diet.—The expression a "square meal" is often used. This idea may be conveniently adapted to express a balanced diet in diagrammatic form. If each meal, or at any rate the day's food, is planned to comply with this standard, then the whole diet automatically becomes balanced. In the diagram (Fig. 1) a circle represents the proximal principles, carbohydrate, fat, protein, mineral salts, and water. To square the circle four corners must be added. These corners represent vitamins A, B, C, and "good" protein, A, B, C, and P respectively in the diagram. The size of the circle may be conceived as varying with the individual appetite which corresponds approximately with the caloric requirements. The foods which supply each vitamin can be arranged schematically, so it can be seen at a glance what items must be included to fill each corner.

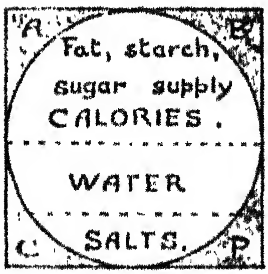


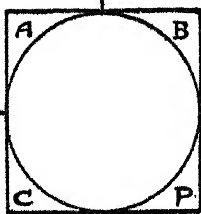
Fig. 1. A balanced diet.

Vitamin-A is most abundant in animal fats and

green vegetables. Vitamin-B is most abundant in whole cereals, nuts, and other seeds, eggs, the internal organs of animals, and to a lesser extent in root vegetables. Vitamin-C is most abundant in fresh juicy fruits and green vegetables.

"GOOD" FOODS, SUPPLYING VITAMINS.*

VITAMIN-A. Cod-liver oil +++ Butter ++ Egg yolk ++ Liver ++ Beef fat ++ Heart + Mutton fat + Milk + Herring, mackerel + Green vegetables ++	VITAMIN-B. Wholemeal cereal products ++ Dried peas and beans, lentils + + Egg yolk ++ Liver, heart, pancreas, brain, kidney ++ Nuts ++ Yeast +++ Yeast extract (marmite), +++ Root vegetables + Potato +
VITAMIN-C. Fresh fruits, especially orange, lemon, grape fruit, tangerine, tomato, +++ Raspberry, blackberry ++ Peach ++ Other fruits mostly + Raw green vegetables+++ Cooked green vegetables (if cooked for short time) + Potatoes + Swede turnips +	"GOOD" PROTEIN. Meat. Egg. Milk and cheese. Fish.



* +++=Very good. ++=Good. +=Fairly good.
Some fruits and vegetables contain little or no vitamin-C : grapes, carrots (unless very young), beetroot, cauliflower, white turnip, jams; bottled, tinned or pickled fruits and vegetables should be regarded as lacking vitamin-C.

A comparison may with advantage be made with similar kinds of foods which do not contain vitamins or merely traces of them :—

"BAD" FOODS, NOT SUPPLYING VITAMINS.

Fats.	Carbohydrates.	Protein.
Vegetable oils and fats do not contain vitamin-A.	*Highly-milled cereals* such as :	*Flesh* of animals are poor in vitamins-B and C.
Margarine made entirely from vegetable fats is therefore poor in this vitamin. Most margarines contain some animal fat.	White rice.	*Pork and white fish* also lack vitamin-A.
Lard.	White wheaten flour.	
Bacon fat.	Cornflour.	**Miscellaneous.**
Pork fat.	Pearl barley.	Bananas.
	Sago.	Tea, coffee, chocolate.
	Tapioca.	Beer.
	Sugar.	Canned and sterilized foods.
	Syrup, treacle.	
	Custard powders.	

A study of the tables of "good" and "bad" foods shows that most natural animal fats and cereals function as vehicles of vitamins, and their value may be spoiled by commercial processes. Vitamins are consumed at the same time as calories, if foods are chosen from the "good" list. Foods from the "bad" list supply calories and sometimes "good" protein, but need to be supplemented by concentrated vitamin foods, such as cod-liver oil or butter for A, yeast extract for B, and orange juice for C. A diet composed of a mixture of "good" and "bad" together must be carefully scrutinized as it may fail to provide *enough* vitamins to maintain good health. As in the case of a diet chosen from the "bad" list, it is safer to supplement it, especially if it contains much white cereals and sugar.

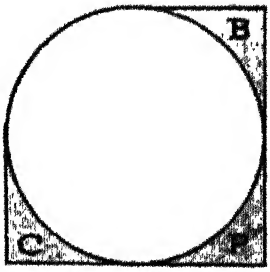


Fig. 2. Absence of vitamin - A causes failure of growth: keratomalacia.

Various Types of Wrong Diets.—The diagram of a "square meal" can be modified to illustrate every variety of improper diet, from those causing the specific deficiency diseases to the generally unbalanced diets such as are commonly consumed. The corners are best considered individually.

Absence of Vitamin-A.—The corner A may be missing. The absence of vitamin-A causes cessation of growth, wasting, anæmia, and lowered resistance to infections. Keratomalacia usually develops. Bronchitis, pneumonia, and catarrh are other infective conditions favoured by this type of deficient diet. Vitamin-A is less important to the adult than the other vitamins, and small amounts of foods containing it suffice to maintain health. Its chief function in adult life appears to be the strengthening of resistance to infection.

Shortage of Vitamin-A.—As distinct from absence, *shortage* of vitamin-A, or of an antirachitic vitamin of similar distribution, is connected with the development of rickets. There is enough vitamin in the food to produce growth at a normal rate, but the bones and teeth are improperly calcified. The deposition in the bones of the lime salts derived from the food depends upon an adequate supply of this vitamin. A study of rickets-producing diets shows a lack of balance in other respects. Invariably there is also a shortage of vitamin-B, and generally a preponderance of carbohydrate. The specific curative effect of cod-liver oil, the foodstuff richest in vitamin-A, suggests that a shortage of this vitamin is the controlling factor in the development of rickets, but Dr. Alfred Hess has shown that less is required if the diet is rightly adjusted in other respects. Sunlight has a beneficial effect upon rickets, and apparently diminishes the in-

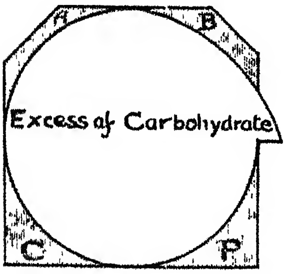


FIG. 3. Shortage of vitamin-A is the controlling factor in the causation of rickets. There is usually also a shortage of vitamin-B and an excess of carbohydrate.

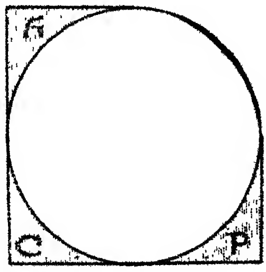


FIG. 4. Absence of vitamin-B causes beri-beri.

fant's requirements for this vitamin. Sunlight has recently been discovered to produce antirachitic power in fats devoid of vitamin-A. The constituent which becomes activated has been found to be cholesterol.

Absence of Vitamin-B.—The corner B may be missing. Diets in which vitamin-B is absent lead to the development of beri-beri after three months.

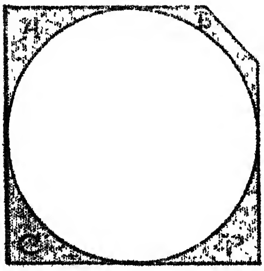


FIG. 5. Shortage of vitamin-B causes gastro-intestinal troubles.

Shortage of Vitamin-B.—Before the symptoms of beri-beri appear there is a period of ill-health in which occur common symptoms met with every day in medical practice. The first signs are loss of appetite, or there is a depraved appetite in which experimental animals are observed to eat their fæces, and, in the case of birds, their feathers and eggs. Weakness, loss of weight, lack of vigour follow, together with anæmia, a tendency to œdema, sub-normal temperature, and cardio-vascular depression. Later, gastro-intestinal derangements appear—indigestion, constipation, colitis, appendicitis; finally, there are symptoms due to the malnutrition of the nervous system. The onset of these symptoms varies according to the degree of shortage of vitamin-B. The greater the shortage the sooner they appear. If the shortage is slight the nervous symptoms may never appear, and the organism suffers only from dyspepsia, constipation, and other intestinal troubles. The body is thus weakened and offers no resistance to invading micro-organisms, or to larger parasites like worms.

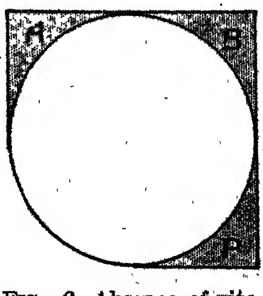


FIG. 6. Absence of vitamin-C causes scurvy.

Absence of Vitamin-C.—The corner C may be missing.

Scurvy develops after four months upon a diet lacking vitamin-C.

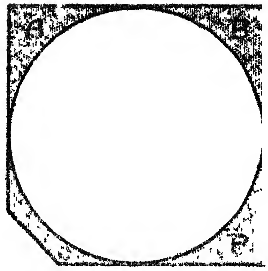


FIG. 7. Shortage of vitamin-C causes ill-health and pains in the limbs.

Shortage of Vitamin-C.—Before definite symptoms of scurvy appear there is a period of ill-health characterized by certain symptoms which may also be looked for in those who habitually take too little vitamin-C, though they get enough to prevent acute scurvy. These symptoms are a sallow, muddy complexion, loss of energy, fleeting pains in the joints and limbs, especially in the legs, usually mistaken for rheumatism. So-called rheumatism in infants and young children has often been proved to be due to insufficient vitamin-C, and is really scurvy, which in its severer form is known as Barlow's disease or as scurvy-rickets.

"*Good*" *Protein.*—The corner P represents protein supplying all the essential amino acids. The biological value of protein cannot be reckoned in terms of nitrogen, but according to its amino acid content. There are some twenty amino acids in the protein of the animal body. "Good" proteins for food are those which supply all the essential amino acids in suitable proportions. The best proteins are derived from animal tissues, such as meat, milk, cheese, eggs, fish. A small quantity of animal protein daily is all that is needed; an excess, as is well known, is harmful. The proteins of plant tissues are "poor," because they contain unnecessarily large amounts of some amino acids and little or none of others. A diet lacking

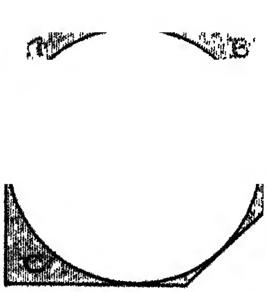


FIG. 8. Absence of "good" protein causes pellagra.

some essential amino acids is associated with the development of the disease pellagra, the prevention of which has been an acute problem in the Southern United States, in Italy, and other parts of the world, where little animal protein is eaten by the poorer classes.

Shortage of all the Vitamins.—In this country the definite deficiency diseases—beri-beri, scurvy, and pellagra—are prevented by the ordinary mixed diet. This does not mean that our diet approximates to the standard of "squareness," nor that we escape the consequences of our errors. Larger and smaller errors in various directions obscure the clear-cut picture of any one definite deficiency disease, but cause a host of small ailments and many cases of chronic illness. Experiment has shown that the greater the shortage of any vitamin the sooner does the deficiency disease arise. With slight shortages of the various vitamins characteristic symptoms take a long time in appearing. In most cases the first sign of illness is loss of appetite, followed by digestive disturbance. Animals may have stoppage of the gut, gastric or duodenal ulcer, or die of appendicitis or other troubles before the typical symptoms of the deficiency disease are shown. During the war the slow healing of wounds was found to be associated with shortage of vitamin-C. Heart and digestive troubles are caused by shortage of vitamin-B. Under all variations of vitamin shortage experimental animals are more susceptible to infections of all kinds. Animals fed on vitamin poor diets have succumbed to epidemics of infectious disease which have not attacked other animals kept side by side with them, but fed on food containing enough of all the vitamins. Details of these experiments cannot be entered into here, but they all prove how intimately health depends upon a supply of food containing plenty of all the vitamins. Lack of cleanliness, bad housing, and confinement do not produce disease in properly fed animals.

Two common types of deficient diets may be picked out for special consideration. The type of wrong diet common amongst the richer classes shows an excess of fat, sugar and protein, and of vitamin-A. The use of white bread, white flour, and other white cereals, and of too much sugar, upset the balance of vitamin-B. This diet is constipating, and, there is reason to believe, cancer producing.

Contrasted with this type is the type of diet common amongst the poorer classes. In this case potatoes are

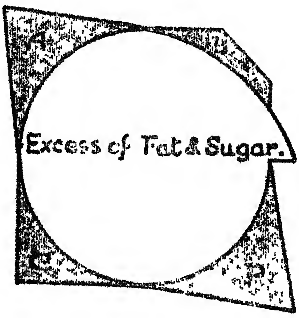


FIG. 9. Deficient diet of the richer classes: excess of fat, sugar, protein; shortage of vitamin-B.

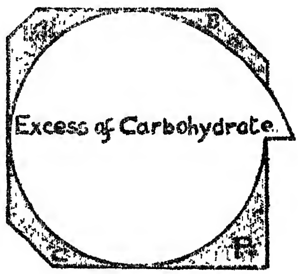


FIG. 10. Deficient diet of the poorer classes: excess of starch and sugar; a shortage of all the vitamins, especially of vitamin-B.

practically the only source of vitamins-B and -C. The food consists very largely of white bread, varied with small amounts of cheese, bacon, meat, fish, etc., and usually there is a good deal of sugar. Many examples of such diets are given in Rowntree's study of "Poverty." There is an excess of carbohydrate and a shortage of all the vitamins. The protein supply is fairly good, except amongst the very poor. This diet is also constipating; it lowers the resistance to infections such as tubercle, influenza, pneumonia.

Fig. 10 is also illustrative of the diet of a bottle-fed baby fed on milk and water thickened with a white-floury or malted food.

The preponderance of carbohydrate unbalanced by

vitamin-B is a fault common to the food of both rich and poor, and may have some connection with the occurrence of diabetes.

The Quantity of Vitamins Needed.—In the absence of chemical knowledge of the vitamins there are consequently no exact data of the amounts of each of the vitamins in the various foodstuffs, nor of the amounts required by the body for the maintenance of health. A great deal of work has, however, been carried out to ascertain how much of the several vitamins, as reckoned in terms of foodstuffs, must be taken to prevent the characteristic deficiency diseases. The amounts thus determined are the minimal, and it is likely that they may be larger, since the experiments were of comparatively short duration. In all cases the quantities were larger than might be expected, especially as some of the original experiments gave the idea that only very small quantities were needed. It is commonly believed that the ordinary mixed diet must provide plenty of vitamins, but this is incorrect.

The Quantity of Vitamin-C.—The most complete series of experiments upon quantitative vitamin requirements are those with vitamin-C carried out by Dr. Harriette Chick and her colleagues at the Lister Institute. The guinea-pig was used as the experimental animal, but in some cases monkeys were also used. A large number of fruits and vegetables were tested, as well as the effect of heat, drying, and the influence of chemicals. The experiments were designed to be of a practical nature. Many were made during the war to find out the most suitable antiscorbutic for armies operating far from a base. Others were devised to ascertain the effect upon the vitamin-C in milk of the various commercial and domestic processes to which it is subjected.

The data obtained with guinea-pigs may be thought inapplicable to man, but they can be compared with

an old naval test on sailors. On long voyages scurvy was not prevented by an allowance of $\frac{2}{3}$ oz. of lemon juice per day, but no cases were observed with an allowance of 1 oz. This figure makes it possible to recalculate the data obtained with guinea-pigs in terms of man's requirements, as summarized in the following table :—

Foodstuff.	Guinea-Pig.	Monkey.	Man.
Lemon juice or orange juice.	1·5 c.cm.	1·5 c.cm.	1·0 oz. daily
	Found.		Calculated.
Cabbage (raw) - - -	1·0 gm.	—	0·6 oz.
Cabbage, cooked ½ hour -	20·0 gm.	—	13·0 oz.
Swede turnip juice - -	2·5 c.cm.	—	1·6 oz.

For other data, see books on "Vitamins and the Choice of Food," Plimmer, page 61; and "Food and Health," Plimmer, p. 17.

The Quantity of Vitamin-B.—The quantity of vitamin-B which is required has been found to be related to the food consumption. This relationship was first indicated by the work of Braddon and Cooper. Plimmer and Rosedale found it necessary to balance the carbohydrate of the diet by vitamin-B in order to rear chicks to maturity. Their further work has shown that not only the carbohydrate, but also the fat and protein must each be balanced by vitamin-B. In other words, the ratio vitamin-B / total food must be constant. Using yeast extract, or dried yeast, as source of vitamin-B, chicks on a diet of white rice, fishmeal, and cod-liver oil needed 10 to 12 per cent. in the diet for satisfactory rearing. Pigeons needed rather less, from 8 to 10 per cent., and other birds rather more. Experiments with rats have indicated that at least 4 per cent. must be present in the food. Man's requirement used to be considered the same as the rat's, but a higher figure, approaching that of the bird, is not by any means excluded.

In view of the large amounts of yeast extract needed to balance white flour, it is of great import-

ance to know the comparative value of the various foods.

Investigations of the comparative amounts of vitamin-B in various articles of food were carried out at the Lister Institute, first by Cooper and later by Chick and Hume, using the pigeon as the test animal. The amount of each foodstuff needed to prevent beri-beri in a pigeon on a constant ration of white rice was determined. The data may be given briefly :—

	Grams per day.
Yeast extract (marmite)	1·0
Wheat germ, free from bran	1·5
Pressed yeast	2·5
Lentils, whole seed	3·0
Egg yolk	3·0
Ox liver	3·0
Peas	5·0
Ox heart	5·0
Ox brain	6·0
Sheep brain	12·0
Beef muscle	20·0
Cow's milk, more than	35·0

The comparative vitamin-B content of various foods is being investigated by Plimmer and Rosedale. The amount of food containing vitamin-B that must be present in a diet otherwise consisting of white rice or white flour and 5 per cent. fishmeal, to ensure long maintenance and reproduction, is being determined. Some of the figures are the following :—

	Per cent.
Oatmeal	95
Wholemeal flour	75
Whole barley	65
Whole rye	55
Wheat germ	8–10
Yeast extract	8–10
Dried yeast	8–10
Dried peas	40
Boiled potato	90

Sufficient vitamin-B in the diet is thus only given if it consist of 95 per cent. oatmeal, or 75 per cent. whole wheat flour. The corresponding figures in the case of

rats would be approximately 50 per cent. whole wheat, 30 per cent. rye, 75 per cent. oatmeal.

These data are of significance when we consider that the average diet consists of two-thirds carbohydrate.

The Quantity of Vitamin-A.—Experiments of the same kind as those above do not appear to have been made with vitamin-A. The long series by E. Mellanby with dogs have clearly shown that 10 c.cm. of cod-liver oil in the daily food always prevented rickets. The food consisted mainly of bread, about 150 to 180 grams daily, so that 5 per cent. in the food is the approximate requirement for dogs. McCollum prevented rickets in rats with about 3 per cent. of cod-liver oil daily. Drummond found that a few drops of cod-liver oil was ample to promote growth of rats. Zilva, Golding, and Drummond cured rickets in pigs by the daily addition of ½ oz. (=1·25 per cent. of the total food); the basal diet providing enough A to promote growth but not enough to prevent rickets. In the case of chickens Plimmer and Rosedale found 1 per cent. of cod-liver oil was enough to ensure normal growth. It is thus very difficult to state a minimal quantity of cod-liver oil for incorporation in the food of animals.

A rough comparison of the vitamin-A value of different fats has been given by Drummond: beef fat was four-fifths, and mutton fat one-fifth as good as butter. Zilva estimated cod-liver oil as 250 times as rich as butter in vitamin-A. The fact that the amount of vitamin-A in animal fats varies according to the food of the animals makes it difficult to determine the comparative values of fats as a source of vitamin-A.

The Variability in the Vitamin Content of Certain Foods.—Animals cannot synthesize vitamins, but derive them directly or indirectly from plant tissues. On this account the vitamin value of milk varies greatly according to the time of year. Milk, cream, and butter from cows at pasture in the summer are far richer in

vitamin-A than from stall-fed cows in winter. The fat content of milk is higher in winter than in summer, but the amount of fat bears no constant ratio to the amount of vitamin-A. It has been shown that the quantities of vitamins-B and -C also vary according to the food of the cows. Consequently, nursing mothers should eat plenty of the vitamin-containing foods.

Destruction and Loss of Vitamins.—Vitamins are lost from the food by the various processes used in its preparation. Each vitamin gets lost or destroyed in a different way. Vitamin-A is very sensitive to oxidation, especially at high temperatures. Thus vitamin-A in milk withstands sterilization in closed vessels, but it would be destroyed in fat used for frying as it is then exposed to heat and air. It is also destroyed by hydrogenation, the process used to harden oils for margarine.

Vitamin-B is stable to heat except at high pressure, as in canning meat, etc. Through its solubility it is washed away from vegetables cooked in an excess of water. It is therefore better to steam vegetables. The most serious loss of vitamin-B occurs in the preparation of white cereals. The wholemeal contains ample vitamin-B. With two-thirds of the nation's food consisting of white cereal foods and sugar, it is difficult to see how this loss of vitamin-B can be made good by the remaining one-third of the diet, as few foods contain enough vitamin-B to balance the deficiency in white cereals.

Vitamin-C is the most easily destroyed. The anti-scorbutic properties of fruits and vegetables are lost by drying, heating, oxidation, such as occur in the ordinary domestic and commercial processes. The quantity in cabbage and potato is diminished by boiling for twenty minutes, and altogether lost by long, slow stewing. Heating twice is also totally destructive, as in the boiling of already pasteurized milk. Vitamin-C is

quickly destroyed by alkali as in the cooking of vegetables with soda to preserve their green colour. Infantile scurvy has been caused by the use of citrated milk. Sodium bicarbonate is equally injurious.

Roughage and Vitamin-B.—Foodstuffs, especially those of vegetable origin, contain, in addition to the five essential constituents, different amounts of cellulose, or fibre, commonly termed roughage. The fibre, not being digestible, is generally considered to play no direct part in nutrition, but is believed to aid peristalsis and evacuation of the bowel. It is for this reason that filter paper, or agar, is added to the food in many animal experiments. The material thus acts as bulk. Plimmer and Rosedale have kept birds and also rats* for long periods, in some cases for over two years, in which time they had reproduced, on diets containing a minimum of cellulose. The long maintenance and reproduction were only possible if the diet contained *sufficient* vitamin-B. Other birds on similar diets, but with too little vitamin-B, were observed to suffer from the early symptoms of polyneuritis, such as constipation, and were cured by a dose of yeast extract. It was noticed that these animals emptied their bowels after the dosage with vitamin-B before the cure took place. Cellulose in the ordinary diet of man is derived chiefly from the bran of the grain. Bran contains vitamin-B. The assumption may, therefore, be made that one of the effects of roughage is the introduction in the food of vitamin-B, which aids peristalsis.

This is not likely to be the only explanation of the action of roughage. In the absence of vitamin-B, birds suffer from stagnation of food in the gut. Putrefaction then occurs, with the production of various toxins. It is suggested that beri-beri is due to the absorption over long periods of small quantities of a toxin, derived from

* Not yet published.

the decomposing protein of the food in the stagnant gut, or even from damaged intestinal wall. Cellulose is a good absorbent of dyes and other chemical substances, so that it may serve as an absorbent of the toxins produced during the time of constipation, and thus prevent their harmful effect. China clay and charcoal, as used therapeutically, probably act in this way; paraffin may be a solvent of the toxins. In all cases, the toxin is removed and prevented from being absorbed into the blood. Roughage would thus appear to be unnecessary in a diet with sufficient vitamin-B, but, in a diet containing a shortage, it may act as an absorber of toxins arising from constipation and prevent their introduction into the circulation.

The same explanation may be given for the beneficial action of charcoal and chalk, which are so often used in the rearing of pigs. Roughage could serve further by forming a layer of impermeable material along the wall of the intestine preventing the absorption of toxin.

The vitamin problem is of far greater importance than is generally realized. The harm done by forty years of wrong feeding can never be entirely repaired by belated attention to the need for vitamins—the structural damage having gone too far. The use of vitamin-containing foods may prevent the damage from getting worse. The vitamin question should be first attended to in the bringing-up of infants and young children. Day-old babies can be given their vitamins in small doses in concentrated form with their milk, if artificially fed; if breast-fed the mother should take additional amounts of the foods rich in vitamins. In this way the foundation will be laid for a sound constitution. Particular attention must be given to vitamins throughout the whole period of growth—in fact, with our present-day habit of eating refined and preserved foods it should never be relaxed at any age.

Diet and Health.

By DR. M. HINDHEDE.

Director of the Laboratory for Nutrition Researches in Copenhagen.

SINCE 1910, when the Danish State granted me the means which enabled me to devote all my time and energy to the investigation of the problem of nutrition, it has been my purpose especially to inquire into the value of each of the most important Danish foodstuffs. The reason that similar experiments have not hitherto been carried out on a large scale in man is, no doubt, principally because it has been impossible to find persons who could tolerate living solely on single food substances for a long time. In Copenhagen we were particularly fortunate, for my assistant, Mr. Frederik Madsen, who had previously been a strict vegetarian for ten years, had trained himself to live chiefly on bread, porridge, potatoes, and margarine. Moreover, without being a complete vegetarian, I had experimented on myself and my whole family with a somewhat similar diet fifteen years previously. We therefore had no misgivings in putting ourselves on a very one-sided diet, as we thought we could always stop if there were objectionable consequences.

In January, 1912, three persons (M.H., F.M., and A.J.) began to live entirely on *potatoes* and vegetable margarine (in summer, with a slight addition of onion to make it more palatable). The experiment was continued for three, eleven, and sixteen months respectively.[1] Both light and very strenuous work were done during the experiment. A.J., who previously had been unable to run a short distance without getting out of breath, trained himself to become an expert runner. In order to be certain of getting down to the protein minimum we tried not only normal potatoes containing

about 2 per cent. protein, but for a long time we ate potatoes which only contained 1·2 per cent. protein. Even with this amount protein equilibrium was maintained. The following is an example:

F.M. Period VII, 2. 19 days.

Diet: 2,560 gm. potatoes, 152 gm. margarine, 45 gm. onions.

	N gm.	=	Protein * gm.	Calories.
Food - -	5·06		31·6	3,916
Fæces - -	1·44		9·0	120
Digested - -	3·62		22·6	3,796
Urine - -	3·41		21·3	
Balance -	-+0·21		+1·3	

* Protein = N × 6·25.

It was thus impossible, even with potatoes which had the least amount of protein, to sink below the protein minimum.

32 *gm. potato protein* (=23 *gm. digestible protein*) *are quite sufficient for a strong adult man.*

It will be remembered that the minimum of N in the urine cannot be reached in a few days; it may take weeks. Experiments of short duration, therefore, signify nothing. On potatoes alone it appears to be impossible to get below the minimum, but with the addition of products poor in protein or free from it, like fruit, sugar, and starch, prepared in the form of fruit porridge, the N can be reduced to any required degree; for example:

F.M. 8 days.

Diet: 700 gm. potatoes, 2,519 gm. strawberries, 162 gm. starch, 375 gm. sugar.

	N gm.	=	Protein gm.	Calories.
Food - -	5·19		32·4	4,391
Fæces - -	5·16		32·2	624
Digested - -	0·03		0·2	3,767
Urine - -	2·67		16·7	
Balance -	-—2·64		—16·5	

Most of the different kinds of fruit contain practically no protein, for what protein there is occurs almost exclusively in the skin and seeds, which are passed quite undigested. Further, fruit seems to accelerate the passage through the intestine (without producing diarrhœa or other trouble), so that absorption of the proteins of the other food substances is diminished. Prunes have quite a similar action to that of strawberries.

This method of decreasing the amount of digestible protein and thereby the N in the urine is very useful. The addition of sugar and starch alone, which many other investigators have resorted to, is unfortunate, owing to the lack of salts and vitamins. These deficiencies vitiate the result.

In our potato experiments we made the discovery[2] that the potato urine had a striking power of dissolving uric acid. Not only was there no excretion of uric acid, even after cooling, but the urine could dissolve large amounts of added uric acid—seven times its own content—at body temperature. Potatoes thus appear to be an excellent means of ridding the body of uric acid. Perhaps it was, therefore, not altogether fallacious that potato water*—the water in which potatoes are boiled—has been considered to be a good household remedy for gout. Since our results were obtained I have also found that the remedy could be used with success for different gouty lesions. Even old deforming joint lesions can, in certain cases—not in all—be cured.

The case of Dr. Röse is a very instructive example. He was a German doctor who visited the laboratory during our potato experiments in 1912. His interest

* It should be stated that our experimental persons always drank the potato water as well. This is very important, as a large quantity of salts and vitamins pass into the water. The potatoes are thinly peeled before boiling. It is difficult to wash them so clean that the cooking water tastes nice.

in the subject was excited, and on returning home he carried out a nine months' experiment with potatoes and margarine, controlled for a time by Prof. Abderhalden in Halle. Dr. Röse had suffered from neurasthenia and sciatica for many years. He went about with 1 gm. of morphine in his pocket to put an end to his existence if the pain should become intolerable. During the experiment he got perfectly well again. Some time later he subjected himself to a long experiment with an abundant meat diet for scientific purposes, and the old disease returned. The result of this was that he gave up his medical work, bought a cottage in the country, and now lives with his wife and children as a country gentleman, chiefly on a potato diet. I refer the reader to his book.[3]

We will now pass on to the *bread* experiments. Two persons lived for eight months on coarse wheat bread and vegetable margarine only. They felt in excellent condition.[4] They also lived for a long time on our sour, coarse rye bread. They also felt well enough on this, but they were sometimes troubled a little by a marked development of flatus in the intestine when they took the large amounts of bread. The following may be given as an example:

F.M. 12 days.
Diet: 1,000 gm. coarse rye bread + 125 gm. margarine.

	N gm.	= Protein gm.	Calories.
Diet	11·87	74·2	3,801
Excrement	4·42	27·6	480
Digested	7·45	46·6	3,321
Urine	7·33	45·8	
Balance	+0·12	+0·75	

Equilibrium can, therefore, be attained on 47 gm. digestible bread protein, which is contrary to Rubner's contention that bread protein is of such slight value that equilibrium is not reached until 81 gm. digestible

pure protein are taken. But are the 47 gm. a minimum? Can we not reduce the amount still more?

This question is very important. As a result of various experiments in Germany, America, and England it is regarded as settled that bread protein possesses relatively slight value, so that it must be supplemented with the dearer, but more valuable animal protein. According to our experiments this is a misconception depending on human experiments which are of much too short duration.

On a pure bread diet a minimum cannot be attained, because bread is far too rich in protein. But we made use of the method mentioned, namely, the addition of prune porridge—for example:

H.M. 12 days.

Diet: 500 gm. rye bread, 75 gm. margarine, 575 gm. prunes, 69 gm. sugar, 69 gm. starch.

	N gm.	= Protein gm.	Calories.
Diet	8·41	52·6	3,785
Fæces	4·86	30·4	572
Digested	3·55	22·2	3,213
Urine	3·37	21·1	
Balance	+0·18	+1·1	

Here we have equilibrium on just as low a standard as in the case of potato protein. There are 11·5 gm. prune protein in the diet, which seems to be rather indigestible. On keeping it for twenty-four hours in the thermostat with pepsin—HCl, which is a very drastic treatment and digests more than the intestine is able to do, only 33 per cent. of the protein of the prunes was dissolved, which presumably is present largely in the skin, and this appears to pass through the intestine unchanged. The following table shows the protein balance on the bread and prunes diet:

Period No.	F.M. Number of days.	Digested N.	N in Urine.	Balance.	H.M. Digested N.	N in Urine.	Balance.
IV	22	4·00	4·71	−0·71	3·17	4·05	−0·88
V	12	4·76	4·81	−0·13	4·74	5·09	−0·35
VI	12	5·07	5·29	−0·22	4·99	4·66	+0·33
VII	12	4·53	5·11	−0·58	5·13	4·77	+0·36
VIII	12	3·70	4·44	−0·74	*3·55*	*3·77*	−0·22
IX	12	*3·01*	*3·57*	−0·56	5·63	4·37	+1·26
X	12	*3·33*	*3·62*	−0·29	4·84	4·53	+0·31
XI	12	*3·64*	*3·50*	+0·14	*3·16*	*3·55*	−0·39
XII	6	*3·69*	*3·36*	+0·33	*4·01*	*2.85*	+1·16
XIII	8	*3·82*	*2·83*	+0·99	*3·00*	*3·27*	−0·27

If the means are taken for some of the periods where the experimental persons showed the lowest values for digestible N—the italicized ones—we obtain:

	Digested N.	N in Urine.	Balance.
F.M. 50 days, per day - -	3·45	3·42	+0·03
H.M. 38 „ „ - -	3·38	3·32	+0·06

The conclusion I have drawn from this is:

3·50 *gm. digestible bread N, which is equivalent to* 22 *gm. digestible bread protein, is sufficient to keep strong young men in protein equilibrium.*

But this means that the bread protein in bread of unbolted meal has the same value as the protein in meat and milk. The opposite results, as mentioned, are due to experiments lasting much too short a time. It was thirty-four to ninety-four days before our experimental persons got into perfect equilibrium. Did this long underbalance have any injurious effect? Certainly not, for the individuals felt in excellent health, and had an unusual capacity for work and endurance.[5]

It is now thirty years since I made my first experiment on protein underfeeding; I lived one month on new potatoes, with butter and strawberries and a little milk. It was just the feeling of well-being which accompanied the diet that shook my faith in the old dogmas. Since then I have become convinced that many of the really good results obtained by apparently quite unscientific "sanatoria for natural cures" (fruit diet,

raw food, hunger and thirst cures) are due precisely to protein underfeeding. The accumulation of old protein products is presumably a source of many chronic diseases. "The stronger histolysis (through negative protein balance) is, the more rapidly does the cure progress," writes Dr. Sandoz in his book on natural cure methods.[6]

By means of experiments on rats, Osborne and Mendel have demonstrated the slight value of certain cereal proteins. Rather is it remarkable that such substances isolated by complicated chemical processes have any value at all. The two authors write[7]:

"It has been demonstrated conclusively that some of the individual proteins, like zein (maize), gliadin (wheat), and hordein (barley), for example, are chemically defective and correspondingly physiologically inadequate proteins. Hence a misunderstanding of the possible value of the cereals as source of protein has developed in the minds of some persons, owing to their failure to realize that in the form in which these grains are most commonly fed the sum total of their various proteins must be taken into account."

The same authors have also shown that the protein of the wheat kernel is not of full value. Rats do not thrive well on fine bolted meal unless animal products are added. But they thrive well enough when bran is mixed with it. They write[8]:

"The crude protein of bran appears to be quite as efficient as that of the combination of wheat-flour with egg, milk or meat, under the conditions of this experiment."

This falls quite in line with our results. We were able to live in the best of health for apparently unlimited time on coarse bread and margarine, but as soon as we attempted to live on ordinary white bread, plus margarine or butter, we became so lazy in the course of two to three weeks that we could hardly

walk. This was, of course, chiefly due to the lack of vitamin-B, but the deficient protein may have taken some share.

Bran seems to be quite an excellent food material. But it is said to be indigestible by man. This, again, is an error. Our experiments showed that man, curiously enough, digests bran to much the same extent as the domestic animals. The validity of these "incredible" results has been confirmed by Prof. Wiegner in Zurich,[9] and by Prof. Johannson in Stockholm.[10]

We have made a number of other experiments, of which I shall only mention that two persons lived six months on barley-water porridge, sugar, and margarine. One of them, who was a patient when the experiment was begun, increased 10 kg. in weight during the experiment, and got perfectly well.[11] Later we tried to omit the margarine and let them live on barley-water porridge and sugar only, but this did not succeed. The men decreased in weight, and lost their appetites. Even vegetable margarine seems to contain vitamins in sufficient quantity for adult men.

What has surprised us most in all our innumerable experiments was to see how little adult men need vitamins. It shows that rat experiments may very easily be quite misleading. If one wants to discover the best food for rats, experiments with these animals are the proper ones. But if one wishes to find the best diet for man one can hardly escape using men for the experiment. Rat experiments may give some hints, but one cannot draw correct conclusions for men.

To test the importance of fats we put two persons on a fat-free diet, consisting of cabbage soup with potatoes in it and bread. The experiment lasted two years. The persons in question felt in excellent health, one even increased 9·5 kg. in weight in the first seventy days—with absolutely no fat.[12]

Fats are not a necessity. Green vegetables can replace

fat (butter).

I reported this result in January, 1918, to Prof. Mendel, of New Haven. I proposed that he should give his rats green-stuff instead of butter. Whether it was my advice that was taken or not I do not know, but the fact is that a year later Mendel published a report which showed that spinach could take the place of butter.

THE DANISH WAR RATIONING.[13]

Denmark was spared participation in the war, but we nevertheless felt its effects acutely. We were put in a very awkward position, especially by the complete blockade from February, 1917, which will appear from the following figures: Denmark normally grows 1,100 million kg. of rye, wheat and barley. She imports 1,500 million kg. of rye, wheat, maize and oilcake. Consumption, 2,600 million kg.

In 1917 the importation of the 1,500 million kg. was stopped, and on account of the drought we lost 300 million kg. of our normal crop. We, therefore, had only 800 million kg. But 2,600 million kg. ought to be consumed by the people and the domestic animals. It was quite a desperate situation, and it was not consoling that the Germans were starving although they normally raised about twice as much rye and double as many potatoes in proportion to the population as we did.

Annual harvest in millions of kg. per million inhabitants.

	Germany. 1912–13.	Denmark. 1913–16.	Denmark. 1917.
Rye	175	105	76
Wheat	66	68	40
Barley	54	204	132
Potatoes	767	347	294

The situation seemed desperate, but the solution of the problem was nevertheless extremely easy. The fact merely was that both man and pigs could not live. In Germany the pigs were allowed to live—they were not

slaughtered until it was too late—and therefore men died. In Denmark we reduced the number of pigs to one-fifth, and reserved their food, barley and potatoes, for the people. In addition we reduced our cows 34 per cent., and withheld the wheat-bran from the cows and incorporated it in our coarse rye bread. We thus obtained a bread which not only contained all the rye bran, but 12–15 per cent. of wheat bran extra. It was indeed the coarsest bread ever seen. Moreover, we forbade the production of spirits for consumption, and the English deprived us of coffee and tea. We thus arrived at an impossible diet according to the old theory, but an ideal one according to the new theory. The following figures give a comparison with Germany.

What everyone could get a day at a cheap price:

	Dresden 1917. gm.	Copenhagen 1918. gm.
Meat	14	40
Butter	5	37
Milk (adults, no milk in Dresden)	0	3–400
Bread	214	270
Flour and groats	2	150
Potatoes	90	500

It should be stated that the well-to-do class could buy more beef in the open market, but it was very dear, and therefore beyond the means of poorer folk.

What was the relation of health to this extremely Spartan diet? It was so remarkable that the mortality for the whole country in the first full rationing year, October 1, 1917–October 1, 1918, fell 17 per cent. We came down to a mortality of 10·4 per thousand, the lowest death-rate ever seen in any country. In the last three months of 1918, however, influenza appeared, which quite disturbed the mortality figures. But it is striking to note that Denmark was the only European country which had no higher mortality in 1918 than in the years preceding the war. We cannot reckon with the belligerent nations, but if we take some of the

countries who were not involved in the war we find the following:

Death-rate per 1,000 *living.*

	1908–13.	1916.	Rise + Fall —
1.—Denmark - - -	13·3	13·1	— 2%
2.—Norway - - -	13·5	16·7	+ 24%
3.—Sweden - - -	14·1	18·0	+ 27%
4.—Holland - - -	13·6	17·1	+ 26%
5.—Spain - - -	23·0	33·6	+ 46%
6.—Switzerland - -	15·2	19·0	+ 25%
Mean, 2–6			+ 30%
Mean, without Spain			+ 25%

There is no reason to doubt that, under normal conditions, influenza—which raged furiously in our midst—would have put up the death-rate in Denmark to the same extent as in the neighbouring countries. But we seem to have saved this 25 per cent. by our rationing. It will be said, however, that it was the restriction of spirits that was the cause. This is admitted. The fact that the consumption of spirits fell to one-twentieth was a principal cause, especially in the case of men of middle age. But there are certain classes of the population in which the limitation of spirits has less importance, and they are the older classes, especially the elderly women. As influenza does not play any special rôle either, in the higher-age class, there is reason to believe that the mortality figures will here provide a fairly clear picture of the influence of the other rationing factors.

Annual Death-rate per 10,000 *living. Age over sixty-five years.*

Copenhagen—

	1900–04.	05–09.	10–14.	15–16.	1917.	1918.	19–20.	21–22.	23–24.
Men -	914	905	872	904	926	672	807	830	860
Women	681	717	706	786	778	618	690	742	740

Country—

	1901–05.	06–10.	11–15.	1916.	1917.	1918.	19–20.	21–22.	23–24.
Men -	783	763	738	735	742	572	670	670	683
Women	752	740	735	730	757	595	714	712	696

Ratio, 1910–14 = 100.

Copenhagen—

	1900–04.	05–09.	10–14.	15–16.	1917.	1918.	19–20.	21–22.	23–24.
Men -	105	104	100	104	106	77	93	95	99
Women	96	102	100	111	110	88	98	105	105

Country—

	1901–05.	06–10.	11–15.	1916.	1917.	1918.	19–20.	21–22.	23–24.
Men -	106	103	100	100	101	78	91	91	93
Women	102	101	100	99	103	81	97	97	95

It will be observed that on the whole there has been a tendency for the death-rate to fall from the year 1900 to 1914. In the first years of the war a distinct rise occurred in Copenhagen, which was due especially to diseases of the respiratory organs, and is naturally explained as a result of the shortage of houses and the lack of coal. Families had to huddle together in small single rooms. Although exactly the same difficulties continued in 1918, there was a fall of 20 to 30 per cent. In the country no rise of any importance occurred in 1916 and 1917, because housing difficulties were not experienced there, but in 1918 a precisely similar fall took place. This fall was so regular and constant everywhere (including the younger-age classes), that it could not be due to chance. As alcohol could not be the cause in this case—at any rate as regards the women—it must have been the alteration in the diet. But what were the active factors? This cannot be answered definitely. But it is safe to say that a diet consisting mainly of dairy produce, coarse bran bread, barley porridge and potatoes, and coffee substitute was a healthy diet for the old people, but that it was less fortunate that, when rationing was abandoned, they returned to a heavier meat diet with ordinary white bread and genuine Mocha coffee. I have worked for many years to induce my countrymen to return to the simple peasant's diet which they lived on in the country fifty years ago. I have maintained that this diet, mainly consisting of dairy produce and vegetables, was the most healthy besides being by far the cheapest.

During the period of rationing I had the opportunity of helping to introduce the old diet of the peasants again; and the results quite came up to expectations. I do not think that there is any scientific man in Denmark now who will dispute that the ideas of Chittenden and Hindhede were right, and that the high protein standards were a fatal mistake. If the Germans had not been hampered by these old delusions, but had rationed the nation according to the Danish method, no one in Germany need have starved.

But it is one thing to know the way and another to follow it. Ancient customs, habits, and usages are the world's greatest fetters. But how important it would be in the present critical times if the people would learn to adopt the simple peasant's diet, which would save half the money spent on food. This economical side of the question has awakened the greatest interest in my native country, but it lies outside the bounds of the present article.

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Diet and Personal Habit.

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URBANIZATION, the importation of much of our food, and other factors have made many changes in the national dietary. We consume thirty times as much sugar as we did in 1700. We use margarine and jam instead of butter, and refined cereals, tinned meat, and many foods containing preservatives. Home-grown fruits, vegetables, and dairy products are more difficult to obtain. The basis of the diet of children in the poorer districts of our large towns is frequently white bread, jam, margarine, very little milk, some meat—probably tinned, sugar, and sweets. Such a diet is very lacking in vitamins. There are indications that the results of these dietary changes are not satisfactory. Thus, there is widespread dental decay and constipation and stunted growth. The bad recruiting statistics of the war still continue. Rickets is lessening, but is still too common. Tuberculosis is still rife, and its death-rate during recent years more or less stationary. Cancer exacts an appalling toll, and about one in four or five of those who reach the age of fifty is fated to die of it. The worst food habit is constipation and the habitual use of opening medicines. Opening medicines are chiefly necessary because we eat the wrong food or too much food. Why should people accept aperients as inevitable when, by including in their diet plenty of fruit and vegetables and wholemeal bread, they can obtain the roughage necessary to stimulate the bowels, and the vitamins needed to maintain the integrity of the intestinal mucous membrane and the digestive system? As regards over-eating, it is not sufficiently

recognized that as we get older and lead more sedentary lives we need considerably less food, and that the man of, say, sixty, who needed food producing 3,000 calories when he was forty, now only requires food yielding 2,000 calories.

For the prevention of dental decay a vitamin-rich diet is needed for expectant and nursing mothers, and for the child after it is weaned. Dentists agree that the habit of giving too pappy food to the weanling has been overdone, and that the child should be given food to make it chew and exercise its jaws. Its vitamin-rich diet will provide the right kind of fat for forming good dentine and enamel. As the child grows older it can readily be taught to acquire the taste for fruit instead of the taste for sweets. There is general agreement among dentists that the habit of sweet sucking between meals is one of the most fertile causes of dental decay, and also that it is a mistake to give children soft, starchy biscuits between meals and last thing at night. In fact, three meals a day, with a tooth-cleansing food at the finish, and nothing in between is the best rule alike for the child's teeth and stomach. It is irrational to brush the teeth before breakfast so that they may be clean for ten minutes and leave them more or less "clogged-up" with fermentable sugar or starch for the rest of the twenty-four hours. Many children go short of the right kind of fat to supply them with their quantum of vitamin-A, and fall victims to rickets and tuberculosis, necessitating expensive institutional treatment. It is not realized in many families that the growing child requires more protein in proportion to its body weight than its grown-up father, who is doing hard work. The hard work of the father should be accomplished on fuel food and not on large quantities of meat. In his recent book, "Food in Health," Professor Plimmer stresses the dominant position of vitamin-B in the whole question of nutri-

tion, and the danger arising from the fact that many dietaries only contain a minimal quantity, in the absence of eggs, and if white bread is used. Some have expressed the opinion that the yeast used in making white bread contains a protective quantity of vitamin-B.* Professor Plimmer instances the diets containing white bread which failed to prevent beri-beri among our troops in the Dardanelles, and considers that the amount of yeast used in making white bread is too small to be of any account. In the case of our troops in the East, the shortage of vitamin-B was made good by the inclusion in the rations of yeast extract. Its household use can be thoroughly recommended for the purpose of ensuring a sufficiency of vitamin-B. This brings us to the much-discussed bread question. The first essential is for the purchaser to know, when he buys flour or bread, what he is really getting. Is he getting endosperm only, endosperm and germ, or endosperm, germ, and bran ?

Brown bread may mean anything. If the purchaser knows what he is getting as flour or bread it is possible to advise him how to compensate for its deficiencies in the other articles of his diet.

Improvements in the nation's dietary can only come about by free choice after the spread of knowledge. The medical profession is the obvious agent for spreading such knowledge. When these food questions come up at medical meetings, however, so much difference of opinion is expressed on details that the public loses sight of the remarkable unanimity which exists among us as to recommendations for improvement. Thus, although some of the workers in the important research work of the last twenty-five years may lay most stress on vitamins, others on the mineral salts, others on the good quality of the protein, etc., all are agreed that the national dietary would be vastly improved by the freer use of dairy products, fresh fruit, and vegetables.

There is also fairly general agreement that the average man should attain his calories from about $3\frac{1}{2}$ oz. of protein, $3\frac{1}{2}$ oz. of fat, and 14 oz. of carbohydrate.

To digress for a moment: some confusion must be caused to the public by the ambiguous use of the word nourishment. Thus, the frequently made statement "There is no nourishment in white bread" seems to imply that fuel foods are not to be counted as nourishment. What do we really mean by nourishment? Is it to be regarded as a synonym for all our food, or are we to reserve the term for the foods which promote growth, the repair of tissues, and the manufacture of secretions, namely, the proteins, vitamins, and mineral salts. According to this view we would only require to obtain about 400 of our daily calories from "nourishing" foods. Confusion at once arises from the fact that the fuel foods may become part of the body as fat, and that the vitamins are needed to preside over the digestion of the fuel foods. It seems better to accept the alternative, and to regard all foods which are capable of providing for our growth maintenance and energy as nourishment, and to discourage the use of such misleading statements as "There is no nourishment in this, that, or the other food."

In order to get reasonable uniformity in our advice we must have some tolerance of varying opinions. Thus, there is room for latitude in the amount of protein laid down, and the fat may be reduced somewhat, and the carbohydrate increased. Most of us prefer half the protein to be animal, but we recognize that some people make a good showing on nuts and fruit, and some on nuts, fruit, and vegetables, and we are not surprised that fruit and vegetables, with the addition of eggs and dairy products, can form a good diet. We want to avoid extremes. We all recognize the advisability of thoroughly chewing our food from infancy onwards, though we may not be Fletcherites, and

though the tradition that G.O.M. stands for grand old masticator may be exploded. We recognize the benefit of drinking some water between meal-times, even if we do not get up to as much as three quarts per day. We recognize that excessive liquid at meals retards digestion, but few of us would say that "dry" meals are necessary for healthy persons who do not know the strength of their own gastric juice. Tea is supposed to retard digestion, but that is probably chiefly when it has been stewed. Little food is consumed at afternoon tea, but those who go in for "high tea" drink considerable quantities of tea with a substantial meal. On the whole it would appear unwise for the medical profession to attempt to advise exactly how much liquid, whether water, tea, or coffee is allowable with meals, but rather it should be pointed out that from three to four pints of water should be drunk daily, and that food should be thoroughly masticated and not "washed down."

Many people do not drink enough water, and many find that it helps them to avoid constipation if they drink a tumbler of water before going to bed and on getting up. Alcohol is, of course, in no sense a necessity for a healthy person, and those who aim at being at the top of their form, bodily or mentally, are practically abstainers. Alcohol is not a food as ordinarily taken at meals, but physiologists tell us that 2 oz. may take the place of its equivalent of carbohydrate, and thus act as a food if taken in very small doses spread out through the day. Thus, we might get the food value from the alcohol in 1½ pints of beer, or a bottle of claret, if taken in twelve two-hourly doses. In view of the experiments on the exactitude of work after alcohol, the physiologist would not permit its use at the midday meal during the working day. Those who take it after work, at dinner or supper, should take it because they like it, and not because it does them good, in the

hope that the quantity taken will not be enough to retard digestion. If father's expenditure on beer or wine means that little Mary has margarine instead of butter, father's course is obvious! Alcohol is dangerous for the child if taken by nursing or expectant mothers, and the recommendation of stout for nursing mothers has become obsolete. Another of the wrong habits is the attempt to overfeed expectant and nursing mothers. If after the child is born the mother's extra work is to manufacture a pint of milk per day to enable an 8 lb. baby to double its weight in a few months her extra food requirements will not be great, and will be less still during pregnancy. During both periods a careful choice of food to provide against the drain on her calcium and vitamins is the main desideratum. Apart from the needs of the child her own food needs may be less than usual owing to a diminished output of activity.

So much for the education of the public. Some additional arrangement, however, is required to ensure that people know what they are buying when they buy bread and flour, and also food substances sold under misleading names, such as invalid wines containing no alcohol, custard powders containing no egg, lemon cheese not made of the recognized ingredients, etc. New questions are constantly cropping up under the Sale of Food and Drugs Acts, and single local authorities will not shoulder the expense of fighting a manufacturers' federation up to the House of Lords on a point affecting the population of the whole country. A central body appointed by the Ministry of Health and Medical Research Council could take up these food questions with the trading associations concerned, and make regulations as to standards, notices to the purchaser, and the use of misleading names.

Bread in Relation to Diet.

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THE only form of bread which is really in general use in this country is bread made from wheat, and in this article only that kind of bread will be considered. Bread can be made from some other cereals, alone or mixed with wheat, but the quantity of these used is so insignificant that it can in no way influence the national health.

Bread is the most important single article of diet that we have, and its origin, as well as that of the cultivation of wheat, from which it is obtained, belongs to the prehistoric period. Wheat was cultivated in Egypt 3,000 or 4,000 years B.C., and probably arrived in Europe about 2,000 B.C., and in Great Britain about 1,800 B.C. In the Beatus caves on Lake Thun, Switzerland, some ancient stones for grinding or crushing wheat have been preserved, which were used by the lake dwellers of the Neolithic period in that country.

The earliest Act of Parliament in England dealing with bread was in A.D. 1260, and this regulated the price by public assize. It remained in force in London till 1822, and in the provinces till 1836.

Up to the year 1870 practically all of the wheat used in England was home grown, but since the introduction of roller-milling into this country from Hungary, about 1872, less and less wheat has been grown at home, and increasing quantities have been imported from abroad.

Wheat grown in different countries may vary enormously in the chief constituents, but by blending the varieties on their arrival here, millers have been

able to maintain considerable uniformity in the composition of the flour made from it.

If a section of a wheat-grain be examined, it will be found to have a dark-coloured outer coating or skin, and a large white centre or endosperm. At one end of the grain will be found the germ, which lies superficially and is protected by the outer coat. This latter is known as the pericarp, and has three sub-divisions, known as the epi-, meso- and endo-carp; these form the bran. Just inside the epicarp is the dark-coloured testa or episperm, and under this comes a hyaline layer, perisperm or nucellus; lining this latter and situated between it and the endosperm comes a single layer of large cells rich in protein but free from starch, called the aleurone layer. The parenchymatous cells of the endosperm contain starch grains and small gluten granules. The outer layers form about 15 per cent. of the grain, the endosperm 80 per cent. or more, the aleurone 3 or 4 per cent., and the germ 1·5 to 2 per cent.

Milling generally aims at the removal of the outer layers as far as possible, and utilizing the endosperm for ordinary flour. The outer layers constitute the "offal," which is composed of bran, fine bran or pollard, and "middlings." The germ is generally kept more or less separate.

There are two processes of milling, known as stone-milling and roller-milling. The former is much the older and simpler, and is performed by two large round stones suitably grooved on their inner surfaces and placed horizontally. The lower one is fixed and the upper revolves on it, and the wheat is ground between them. In "low grinding" they are almost touching, and the wheat is reduced to whole meal at one process. This is the genuine whole meal, and when this is obtained by roller-milling the offal must be put back after its removal from the wheat berry. If it is not all put back

it is spoken of in America as "entire flour," which is used for a form of brown bread.

The whole meal obtained by stone-milling is next put through sieves of different fineness, and by this means white flour or endosperm is obtained. It is never so free from offal as that obtained from roller-milling. In "high grinding" the stones are kept farther apart, and the outer coats are removed in the first process, so that one gets white flour or endosperm, and offal known as "middlings." These latter are further treated to extract any flour that adheres to the bran, etc., and this is done in some cases by steel rollers. Only soft wheats like English are suitable for stone-milling.

The process of roller-milling is most complicated, and it has been calculated that from the time the wheat leaves the ship till it becomes flour, it travels about a couple of miles through rollers, sieves, etc.

Wheat on arriving from abroad is generally very dirty. It is mixed with all sorts of particles, such as small stones, dried bits of clay, even nails, grains of barley, and so on. It is first put through a series of sieves known as "scourers." It is next passed through the "barley cylinder," to separate the barley from the wheat. It is also winnowed to get rid of chaff. The next processes are washing in water and drying. After all this cleansing it then goes to the mill proper and passes through several series of steel rollers, run in pairs. The first three or four pairs are fluted and run at different speeds and in opposite directions. They are known as "break rollers," and are concerned with the removal of the outer coats or bran, etc., from the grain, leaving the endosperm, which is broken up into rather coarse particles, known as semolina. This is ground in further rollers and goes to make "break flour," which eventually becomes the purest flour or "patents." The coats are removed as bran in large

flakes, also fine flakes or pollard, and "middlings," a mixture of offal and flour. The middlings now pass through a series of smoother rollers of about thirteen pairs, known as reduction rollers. Between every set of rollers, from the first set of break rollers to the thirteenth pair of reduction rollers, the "offal" formed is removed by sieves, and goes to swell the final bulk of offal, which is sold for animal food. The flour obtained from the reduction rollers varies much in quality, and goes to form the ordinary or "household" flour.

The removal of the germ is a separate process, and when collected it is often put back to form some kinds of brown bread. Millers do not like it in the flour, since its fat may go rancid and spoil the flour. There are various other sieves, made of fine silk, through which the flour has to pass, so that in the end one gets a very pure white flour free from offal or germ.

The following table shows the composition of wheat, and is an average from samples examined by the United States Department of Agriculture, at the Columbia Exhibition, 1893, and cited by Hamill. This corresponds, of course, to the composition of whole-meal flour :—

Weight of 100 grains of wheat	3·87	grammes.
Moisture	10·62	per cent.
Proteins	12·23	„ „
Ether extractives (oil, etc.)	1·77	„ „
Crude fibre	2·36	„ „
Ash	1·82	„ „
Carbohydrates (other than fibre)	71·18	„ „

The moisture may vary from 7 to 14 per cent., the protein from 8 to 17 per cent., and the carbohydrates from 65 to 76 per cent., which shows the necessity of blending if uniformity of flour is to be obtained. To sum up, then, the purest white flour consists of endosperm only, and whole meal of the total grain ground up. White flour from stone-milling is never quite freed from

the offal or germ, since some of these are fine enough to pass the sieves with the endosperm. The same applies to the inferior flours obtained from the reduction rollers, though these may be bleached by nitrogen peroxide obtained chemically or electrically. This is a process that ought to be stopped, since the only persons who profit by it are the miller and baker, for, from a health point of view, it is very questionable.

Standard flour, which created such a stir about twelve years ago, does not possess any very constant composition, and Hamill describes it as containing "the whole of the contents of the endosperm cells (with the exception of a small amount left adhering to the coarse bran in the form of floury particles), the germ and a certain amount of finely comminuted branny particles and cell walls of the endosperm." It can be prepared by stone- or roller-milling. Whole-meal should contain all parts of the berry, more or less finely ground-up together, but many flours are prepared for brown bread by adding different portions of the offal, germ, or both, to ordinary flour, so that the bread known as "brown bread," is an article of very varied composition.

The following table gives the composition of white and whole-meal breads contrasted, and is the result of many analyses by Dr. Robert Hutchison :—

	Water.	Whole-meal.
Water - - - -	40·0 per cent.	45·0 per cent.
Protein - - -	6·5 ,, ,,	6·3 ,, ,,
Fat - - - -	1·0 ,, ,,	1·2 ,, ,,
Starch, sugar, dextrin -	51·2 ,, ,,	44·8 ,, ,,
Cellulose - - -	0·3 ,, ,,	1·5 ,, ,,
Mineral matter - -	1·0 ,, ,,	1·2 ,, ,,

There are some forms of brown bread which undergo special processes, the principle being the addition of germ to increase the protein, vitamin content, and fat.

As an article of diet bread by itself cannot be looked upon as a complete food. It contains too little protein and fat, and too much carbohydrate. According to

Hutchison a proper diet should have the protein and carbohydrate in the proportions of 1 to 4·2, and the fat to the carbohydrate as 1 to 6. In bread, however, the protein is 1 to 8·5 carbohydrate, and the fat negligible. Besides, we do not get full value for the protein ingested, since it is only utilized to about 50 per cent. compared with nearly 100 per cent. in beef. It is plain, therefore, that bread should only be used as part of a mixed diet.

The much debated question of brown bread *versus* white as an article of diet cannot yet be considered as finally settled. Various attempts have been made by food reformers to get people to use flours containing portions of offal, germ, etc., as in "standard flour" and the various brown breads, but the peoples of this country and America still prefer white bread, and provided the diet is sufficiently varied the question is not very important.

Brown bread has some advantages, which I may mention. Its content of fibre gives it more bulk, but less protein and carbohydrate nutriment than the same weight of white bread. The fibre is useful in combating constipation, though the effect is said to wear off in time. It contains a little more vitamin-B (anti-neuritic) than white, and more mineral matter. As, however, this last is largely excreted by the intestines, the excess may be left out of account. The protein especially, and also the carbohydrate in brown bread, are not so easily digested as those in white bread, because the fibre seems to interfere with the digestive juices. The wise course is probably to include some proportion of whole-meal bread in a general diet.

Extra fat and protein should always be eaten with bread, and in this respect the custom of drinking milk and eating butter and cheese with bread is sound.

From an economic point of view, bread must be considered one of the cheapest and best foods, for if its value be reckoned in calories it easily heads the list. A

4-lb. loaf now costs 10d., and as it yields 4,800 calories, this means 480 calories for a penny. There is no other common article of diet which approaches this for cheapness. On the other hand, its very cheapness encourages the poor to rely too much on it, especially in the case of young children, who are often brought up on bread and jam, or bread and margarine, to the detriment of their health and growth. The great excess of carbohydrate aggravates that condition known as the catarrhal or exudative diathesis, the chief symptoms of which, in children, are excess of fat, pallor, enlarged and pigmented abdomen, adenoids and enlarged tonsils, a liability to catarrhs, eczema, rickets, etc. Skin specialists are also agreed that excess of carbohydrate aggravates certain skin troubles, and there is no doubt that a rapid amelioration of all the symptoms mentioned here can be brought about by reducing the carbohydrate and increasing the protein in the diet.

There are many other points one would like to touch on, such as the effect of bread on the teeth, but enough has been said to indicate that the proper rôle of bread is to form a large part of a mixed diet.

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The Influence of Diet on Dentition.

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IN the dental section of the museum of the Royal College of Surgeons is a specimen prepared by the hand of John Hunter, somewhere towards the middle of the eighteenth century, which is of great interest. It is the left maxilla and left mandible of a child of six years. The first permanent molars have just been erupted, and the other teeth have been exposed by Hunter by the removal of the outer bony wall of the crypts containing these teeth. The central incisors, the canines, and the first molars all show a characteristic defect in the enamel of the teeth. As a whole these teeth are somewhat stunted, and the enamel for a varying distance from the edge of the teeth is thin and deficient, especially in the lower jaw.

It is to be noted that these teeth are not yet erupted, therefore the condition is in no sense due to abrasion or trauma, a fact which Hunter clearly recognized, for he prepared several such specimens which are to be found in the collection of Wm. Hunter, now in Glasgow, as well as in the Hunterian collection in London.

Now from the date at which this enamel was laid down we can say definitely that the child suffered from some condition which interfered with the normal laying down of the enamel for the first year or eighteen months. With the unvarying patience of Hunter's methods of observation these teeth were carefully prepared by him, and were set on one side, left, as it were, till further observation would help to complete

the scheme. No explanation was put forward by him to account for the defect.

A century later Jonathan Hutchinson, another indefatigable collector and observer, in many ways resembling John Hunter, was also at work on the subject of the calcification of the teeth. In 1858 he established the fact that a crescentic or semilunar defect in the laying down of the calcium in the two upper central incisors was pathognomonic of inherited syphilis.

Besides this form of defect in the enamel Hutchinson recognized many other and much more common varieties of hypoplasia, and threw out the tentative suggestion that these defects were due to the administration of mercury in infancy. This was a suggestion, not so improbable as it may appear, for at this time mercury was still widely used, and was pushed to produce salivation. "'Tis fit," says Sir John Hill in his Herbal in 1771, "that the world should be reminded that half the defective teeth in young people are owing to mercurials given to children."

In the typical form of hypoplasia commonly met with the teeth affected are the central and lateral incisors, the tips of the canines, and the crowns of the first molars. The condition is symmetrical, affecting both jaws. The biting edges of the incisors are almost always affected, and the deficiency of enamel extends for some distance in the labial and buccal surfaces of the teeth towards the gum. As a rule only the very tips of the canines, and the biting surfaces, with one-quarter to one-third of the crowns of the first molars, are affected. This condition is, I believe, as pathognomonic of rickets as Hutchinson's teeth are of syphilis. While somewhat more common among the lower classes this form of hypoplasia is frequently seen among the well-to-do, and affects some 7 per cent. of the population as a whole at the present time.

In badly nourished children of the very poor one of the chief defects in the teeth obvious to the observer is the chalky appearance of the enamel, which contrasts strongly with the clear semi-transparency of healthy enamel. The chalky appearance varies from white patches, or transverse bands on the surface of the enamel, to a general opacity affecting the whole surface. Closely associated with this, in these poorly-fed and badly-housed children, is the appearance of the brown lines of Retzius, which are due to a brown staining of the enamel running, as a rule, across the incisors, and, it may be, the canines. These lines seem to indicate a severe degree of disturbance of the nutrition in the growing child.

It is obvious that the best defence of the tooth lies in the laying down of a healthy enamel, and the use of the toothbrush and of antiseptic dentifrices can do nothing to produce healthy teeth, though they may help to preserve them when they are defective.

The calcification of the teeth begins about the fifth month of intra-uterine life, and at birth the cusps of the first molars of the permanent set are already laid down. By the end of the first year a considerable portion of the crowns of the two incisors, and of the canines, and first molars of the permanent set of teeth, is already formed. A fact not sufficiently appreciated is that by the end of the fifth year the greater part of the second dentition is already present in the child's jaw, in its permanent form which nothing can alter, long before any of these teeth are erupted, and, therefore, before they can be mechanically affected by the food taken.

What, then, is the influence of diet on dentition? Of late years the vitamin theory has been widely circulated, and has caught the public imagination leading to a multitude of eccentric dietaries and patent foods. Are we to attribute the defective teeth

of the inhabitants of Glasgow, Aberdeen, the Lancashire towns, and of our great industrial areas in general, to defective feeding and to some special lack of care or ignorance on the part of these people? Such a view will not bear examination. Coal-miners, to take a definite class, have long been accustomed to live well, and their food has been the best that money can buy, yet, as a class, their teeth are very defective. In babies fed at the breast by healthy mothers the enamel laid down during the period of suckling is frequently defective. Lack of sunshine and of fresh air and of the opportunities of exercise in the open, met with in our crowded towns and slum areas, are the essential factors interfering with the healthy distribution and utilization of calcium throughout the body, in the bones and nervous system, as well as in the teeth. Given the best feeding possible, sound teeth will not be formed where a large portion of the population is herded into crowded slums and industrial areas under present conditions.

Most of the inferences of the action of vitamins have been drawn from experiments on dogs. The results of dietetic experiments on animals are notably unreliable, and point the danger of dissociating laboratory work from clinical observation. Those experimental conditions produced on the teeth in dogs bear no relation to the hypoplasia found in the child and in the adult. These teeth are mere distended bladders of ill-formed dentine with or without a thin coating of enamel, a condition very different from the dense, hard, resistant hypoplastic tooth of the child, which frequently lasts late into adult life. There is in these animals a well-marked tendency to a peculiar over-growth of the superior maxillæ resembling very closely a condition of slower growth commonly seen in the higher apes at the Zoological Gardens even when these animals have reached adult life. The

condition experimentally induced in these animals strongly suggests an infective process leading in the great majority of cases to the death of the animal and to the destruction of the processes of growth throughout the body. It bears no relation to rickets, and to call it experimental rickets is a misnomer. While the influence of diet on dentition is, in this country, quite a secondary one, it assumes considerable importance in so far as unwholesome foods tend to accelerate the decay of teeth already defective. Naturally, too, a supply of wholesome food is essential if such growth is to be healthily maintained. But it is a badly-balanced diet rather than the absence of any specific factor, such as fat soluble A, which is likely to lead to defects in the growth of the teeth as in that of any other organ or tissue.

The calcification of the teeth begins, as already noted, at the fifth month of intra-uterine life, and a healthy and generous dietary should be prescribed for the mother. As a rule by this time the tendency to nausea and morning sickness has passed away. I do not agree that no alteration need be made in the dietary during pregnancy. Extra milk is of great advantage to the mother and to the growing child, and fruits, especially oranges and apples, are useful additions to the dietary. If the best results are to be obtained these are necessary adjuncts to the ordinary meals of meat once a day varied by fish and egg dishes. The extra milk may, with advantage, be kept up during the period of lactation. By the end of the ninth month the permanent dentition is already far on its way to being well and efficiently laid down.

Scurvy is a condition which has for all practical purposes been abolished from this country, largely due to the universal use of the potato. Probably the majority of practitioners in this country have never seen a case of adult scurvy. There is, however, one

small, but important, exception, and that is in the disease known as infantile scurvy, or Barlow's disease. This is a comparatively rare condition which occurs usually in infants belonging to the better class when the child is rigidly kept to one form of artificial food. It is the only example of a disease in this country definitely known to be due to the absence of a specific food factor or vitamin, and is due to the absence of the antiscorbutic vitamin. In this disease, while there is some swelling and tenderness of the gums, with small hæmorrhages, the condition does not, as a rule, proceed to the loss of teeth and alveolar necrosis, as in the old classic adult cases.

When artificial feeding is carried on the addition of fresh juice to the diet, such as orange juice or grape juice, and, later, tomato or potato, should never be omitted.

For the preservation of the primary teeth and the continued development of healthy teeth in the child beyond the period of lactation, a wholesome mixed dietary is again essential. The teeth are meant for hard wear, and it is necessary that their varied functions should be utilized. The mere mechanical act of mastication tends to promote healthy growth, and to preserve sound teeth. The food, therefore, should not be too soft. Pulpy foods, too, are apt to cling to the teeth, especially round the necks, allowing fermentation and the formation of acids which tend to attack the enamel, and to prepare the way for caries. Especially is this the case where the enamel is thin, or rough and pitted. The healthy instinct of the child to eat apples and oranges at the end of a meal should be encouraged, for not only do they constitute a wholesome food, but they cleanse the teeth most efficiently.

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Late and Early Carcinoma of the Breast.

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Part I.

IN this article I do not propose to discuss the treatment of fibro-adenomata, sarcoma, or dermoid cysts of the breast, or what are at present usually regarded as infective processes, such as staphylococcal and other acute infections, or tuberculosis, syphilis, and other chronic infective processes. My description of treatment depends upon its relation to clinical signs exhibited by abnormal breasts. Hence a preliminary account of the essential signs and symptoms to which reference will be made is of the utmost importance.

First, the position of the patient whose breasts are under examination. A pillow should be placed behind the central part of the back, between the shoulders, so that the front of the chest is thrown forward and the breasts thoroughly exposed for examination. The head is comfortably supported, so that the neck is not curved

backwards. The elbows lie on the couch in a perfectly easy position, so that there is no tension on the pectoralis major muscles and fascias, thus allowing complete examination of the axillary and sub-pectoral regions. Both breasts and the axillæ should be examined. The whole inspection and palpation should be directed towards the following states in which the breast, or breasts, might be involved:

1. A lump.
2. Localized lumpiness.
3. Generalized lumpiness.
4. Discharge of serum from the nipple.
5. Discharge of blood from the nipple.
6. The state of the skin covering the nipple and breast, i.e. whether ulcerated or retracted. The skin and nipple may be retracted in three different ways:
   - i. The subjacent tumour may be in direct contact with these structures, leading to their fixation.
   - ii. The ligamenta suspensoria of Sir Astley Cooper may contain carcinoma; as these ligaments connect the breast with the skin their implication will cause puckering of the latter.
   - iii. A carcinoma that affects the deepest parts of the breast may soon become attached to the subjacent fascia that covers the pectoralis major and fix the breast to that structure. The result will be an indirect pull upon the nipple and skin covering the breast.

   The rare state of tuberculosis of the breast may induce puckering of the skin and retraction of the nipple by means of any of these three methods.
7. The state of the lymphatic glands in axillæ and supra-clavicular regions.
8. State of abdomen, i.e. size of liver or ovaries, ascites.
9. Constitutional state, i.e. emaciation, anæmia.

And the surgeon is to ask himself: How is he going to treat the state presented to him?

CLINICAL STATES—THEIR SYMPTOMS, SIGNS, AND TREATMENT.

Class I.—A. The patient, about fifty years old, is feeble, emaciated, anæmic, and the face has an expression of suffering and anxiety; she presents all the appearances of a patient suffering from the last stages of carcinoma. On examination one of three types of tumour may be found in the breast. It may contain a large tumour, the size of a small orange, with evenly defined edges, and may slip about beneath the skin with no adherence to it. If the tumour is solid, the nipple may be drawn towards its direction, or gentle traction may drag the nipple in its direction. A history of discharge of blood from the nipple may be elicited, or blood may be apparent on the surface of the nipple. On the other hand, this large tumour may have ulcerated; the ulcer readily bleeds, the edges of the ulcer are abrupt and undermined by hard defined growth of the tumour that has not yet ulcerated at that part. This tumour is commonly adult carcinoma.

B. The tumour may be a small one, so small that its presence is detectable at that point from which radiate grooves of puckered skin. At this point a small ulcer may be present, the base and edges of which are abrupt and hard. The nipple is extremely retracted, and the whole breast may be atrophied. On the other hand, the breast may be large, and the position of the tumour may be indicated by one deep groove or pucker. The nipple need not be retracted unless the tumour is near it. There is no discharge of blood. This type of tumour begins in the terminal parts of the ducts and acini, and is not a pure duct carcinoma.

C. The whole breast may be puckered and its surface wavy and irregular, and yet no definite lump

can be detected. The curious thing about this type of advanced malignant disease is that its signs are limited to what would appear to be the shape of a normal breast. The nipple is fixed and retracted, there is no ulceration, and the breast is adherent to the fascia covering the underlying pectoralis major. The state is comparatively rare, and in the four cases in which I have seen it, it has passed through the hands of others with that meaningless diagnosis, "chronic mastitis." Microscopical appearances of these breasts show one of two states:

(*a*) The whole normal breast structure has disappeared and its place is taken by masses of epithelial cells that are separated from each other by strands of fibrous tissue that vary in thickness.

(*b*) Normal areas of breast may be observed, and dispersed among its connective tissue can be seen carcinoma cells, and here and there terminal parts of ducts and acini that are more or less completely filled by epithelial cells which show nuclear hyperchromatosis, mitosis and irregularity of shape.

A, B, and C are three distinct types of carcinoma of the breast. On examining their lymphatic systems, lymphatic glands along the lower border of the pectoralis major, in the axillæ, and in the supra-clavicular regions are found to be enlarged, hard and discrete, or confluent. In the supra-clavicular regions they may be causing venous obstruction of the terminal half of the external jugular vein. They can be felt under the sterno-clavicular attachments of the sterno-mastoid muscle. Venous and lymphatic obstruction caused by their presence may induce œdema of the whole upper limb. In cases of slighter œdema it is noticeable in the skin covering the inner aspect of the arm along the triceps muscle.

Pain, which is localized and referred, is severe, extensive, and often so distressing as to become exquisite on the slightest and gentlest detachment of dressings covering an ulcer. In the chest, the pain

may be induced by pleuritic involvement of the growth where it is more marked at the apex of the lung. X-ray pictures may show shadows beside the aorta and the roots of the lungs and even in the lungs themselves, particularly at the apex. The abdomen may be painless and yet the liver may be felt to be enlarged. On a vaginal examination enlargement of the ovaries may be detected, secondary deposits being present in these organs. There is also ascites.

Treatment :—Patients in these states are in the last phases of life, and it would seem cruel and useless to suggest any surgical interference. There are only two chances of recovery. One is that the patient may be one of those rare cases among thousands in which the disease spontaneously disappears. The other is that at any moment there may be discovered a cure for carcinoma. Even in the latter circumstance the disease may have so destroyed vital organs that its cure may no longer be able to save the patient's life. The question arises: Can a surgeon do anything to ameliorate the deplorable state of his patient? Where ulceration exists, and cutaneous nodules of the surrounding skin are manifest, it would be quite futile to suggest removing any part of the disease. Unirritating antiseptic treatment of the ulcer is the only local treatment that can improve local sepsis and hæmorrhage. Iodoform and iodoform and bismuth gauzes are of the utmost value. Where there is no ulceration and no obvious affection of the surrounding skin, removal of the tumour-containing breast may save the patient from the inevitable ulceration. The improvement in the knowledge of deep X-ray therapy and the intravenous injection of drugs or anti-bodies may some day grant hope of amelioration.

In the classes exemplified in A, B, and C, I have described three types of disease. I want here to emphasize the fact that in many instances items therein may be modified in every direction, e.g. the tumours, ulcers,

and secondary deposits may be larger or smaller in the variety of patients the surgeon must encounter.

Class II.—This type of clinical state exhibits any of the local changes I have described in subsections A, B, and C above, but the patients, in their general states, are quite different. They often look perfectly well; there is no extension of disease to the supra-clavicular glands; they do not appear to be suffering from any visceral complication, yet in this type the lymphatic glands in the axilla on the affected side are enlarged, discrete, hard, and obviously contain secondary deposits of carcinoma. These patients are, as a rule, in a hopeless state so far as cure by operative measures is concerned, and yet with due precautions, which I will mention later, their lives may be prolonged for years by operative measures. The majority of them die within the first five years after operation, but instances are known in the practices of many surgeons and physicians where life has been prolonged for varying periods, even up to thirty-one years, at the end of which latent carcinoma with some degree of suddenness renews fatal activity.

Treatment:—The treatment of these patients is to remove as extensively as possible the breast and its lymphatic distributions. The precautions in removing these, and, indeed, all carcinoma of the breast to which I allude, are mainly directed towards preventing transplantations of carcinomatous cells. First of all, pure carbolic acid or the actual cautery should be applied to an ulcerating surface. This particular precaution possesses the additional advantage of preventing septic infection of the subsequent wound. Secondly, there should be no pressure exerted on the breasts before removal for fear of squeezing out carcinoma cells into parts that previously were free from them. Lastly, should this danger have occurred in spite of the precau-

tion, the wound should be thoroughly soaked in a 1/500 solution of perchloride of mercury. All isolated cells will be killed by this solution. After some experience in this matter I have come to the definite conclusion that so-called recurrences in the areas of operation have become much rarer in my practice. Other surgeons employ the actual cautery in removing such breasts, with the same object in view.

Class III.—A. Patients aged from about forty onwards with a single, well-defined solid tumour in the breast over which the skin puckers, on which alone the diagnosis of carcinoma may be assumed to be correct in the vast majority of instances; yet in this class there are no lymphatic glands in the axilla to be detected either microscopically or macroscopically. There may be a discharge of serum from the nipple of these patients. Where the skin puckers early in carcinoma of the breast, the disease has begun in the terminal parts of the ducts and acini.

B. There is another type of disease of carcinoma of the breast where, as a rule, the tumour is larger than the one just described, in which there is no puckering of the skin over it, and it slips about freely underneath the skin. There may be a discharge of blood or serum from the nipple. The tumour is rounded and can be, as a rule, definitely diagnosed as not being a fibro-adenoma by the fact that the latter tumour would be lobulated. This round, solid carcinoma that does not pucker the skin is one of purely duct origin.

Treatment:—Some surgeons regard these clinical signs as doubtful, on the ground that lymphatic glands are not affected. Hence they remove the tumour for microscopical examination. I have no doubt that this is a dangerous proceeding, and gives rise to widespread diffusion of the disease if carcinoma is present. I

have no hesitation in performing the complete operation for the removal of the breast and all its lymphatic distributions on the clinical signs I have described in this class.

Prognosis :—From a valuable and recent survey of this matter circulated by the Ministry of Health, the fact seems to be emerging that to this class belongs a large percentage of cures. It must be particularly borne in mind that patients suffering from carcinoma of the breast, whose axillary and lymphatic glands are apparently the only other parts implicated, are in as bad a state, so far as the hope of cure is concerned, as those patients in whom widespread secondary deposits are clinically obvious. At this point I would like to describe the microscopical discoveries that were made in six consecutive patients upon whom I operated on the following plan. I made a preliminary incision over the axillary vein and cut through the sternal attachment of the pectoralis major to reach the fat and lymphatic vessels and glands which surround that vein as it passes over the first rib. The fat, lymphatic vessels and glands were removed and microscopically examined by Dr. d'Este Emery. Having removed these structures, I proceeded to perform the complete operation. The result of microscopic examination in one of these patients was that no carcinoma could be found in any lymphatic gland in the axilla, but carcinoma was discovered in the lymphatic vessels surrounding the axillary vein as it crossed the first rib. Hence this patient was suffering from an inoperable carcinoma of the breast so far as cure was concerned. Therefore, even in patients whose axillary lymphatic glands are not macroscopically nor microscopically affected, the prognosis of a possible cure should be very guardedly given.

In the next issue of The Practitioner I propose to discuss the management and treatment of other clinical manifestations of the breast that are so commonly associated with carcinoma in its earlier stages.

The Early Treatment of Mental Disease.

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IN considering the question of the early treatment of mental disease, we may start with the assertion (of the truth of which there is very little doubt) that all mental disease is also physical. In all mental disease there is physical disturbance, however slight, going on somewhere or other in the organism, and in the treatment of such disease it is obviously necessary as far as possible to deal with that physical disturbance directly. Experience shows that a great deal of mental disturbance which may become relatively permanent follows upon infections in different parts of the body, with toxic absorption and consequent deterioration of nervous activity through chemical injury. Again, disturbance of the activity of the endocrine glands, such as the thyroid, etc., has a pronounced reaction on the functions of the nervous system, and so upon the mind. Indeed, these two general physical causes of mental illness or derangement are sometimes related, in that infection and toxic absorption seem to react primarily upon the thyroid gland, and through it influence the nervous system, and so the mind. It is obvious, therefore, that in the treatment of mental disease, due care should be taken to make an adequate physical examination and to deal with the physical infection, from carious teeth, septic tonsils, chronic constipation, indigestion, subacute appendicitis, and

other forms of physical illness, to look for evidence of endocrine disturbances, and to give appropriate treatment in the form of thyroid and other gland extracts, etc. Also, still considering the purely physical side of mental disease, we have to bear in mind the possibility of fatigue and physical exhaustion being factors in the mental trouble, and we should deal with them on the physical side by prescribing physical rest. We need not emphasize these factors, because the whole force of medical tradition is likely to ensure that they will not be overlooked. Even at the present day there is little danger of the physical factor in mental disease being underestimated. The danger is on the other side—that medical men may be too ready to trust entirely to physical methods of treatment and neglect another avenue of approach, namely, the psychological.

At the beginning, one distinction is of fundamental importance, that between so-called functional and organic or structural nervous disease. Mental disturbance is a disturbance of the nervous system, and that may be due to (so-called) merely functional disturbance or to organic and structural change. When we say that a disease is functional we really mean that it shows itself only in the disturbance of function, that the correction of this disturbance of function can be brought about by psychological means, and that this will neutralize or cure the slight structural change that must be present. On the other hand, in so-called organic or structural nervous illness correction of function is inadequate to produce correction of structure.

It is usually said that mental disease often involves a *purely* functional disturbance of the nervous system, with the assumption that there is no structural change. The disease is a purely mental one, and because of that can be corrected by mental means. The difficulty of such a view is that it is impossible to conceive a dis-

turbance of function without some disturbance or other of structure. But nevertheless there is a great difference from the practical standpoint between so-called functional and so-called organic or structural nervous diseases. One set is amenable to mental treatment, the other is not. The reason of this is that in so-called functional nervous disease the disturbance of function can be corrected by special means of a psychological nature, and this correction of function will bring about a correction of whatever slight structural defect was present. On the other hand, in organic or structural disease, correction of structure cannot be produced, because an attempt at correcting function has no influence on the structural alteration.

I, myself, think of it in the following way. In a so-called functional disease such as hysteria, which comes especially in this category, the structural change is a kind of reversible process, whereas the structural change in organic nervous disease is an irreversible physical, chemical, and biological process. Hysterical patients have the defects of their qualities, and the qualities of their defects—they are open to good suggestion and to bad suggestion, to pathogenic and therapeutic suggestion. One means a disturbance of equilibrium in the direction of degeneration, the other a more or less adequate restoration of that equilibrium. There is then this great distinction of the functional and structural which is a helpful indication as to the kind of treatment to be used, if we can first decide whether the disease is predominantly functional. If so it is specially amenable to psychological treatment, because psychological treatment has the effect of altering function and behaviour.

The different forms of mental illness have different mental causes, and call for different mental methods of treatment. In hysteria, suggestion treatment, either with or without hypnosis, may be a quick and satis-

factory method of improving the patient's mental condition, and enabling him to achieve greater powers of mental synthesis for himself, and a higher level of general mental energy. In such pronounced forms as spontaneous or natural somnambulism, hysterical fits, and hysterical amnesias, the patient is invariably found to be easily hypnotizable, and under the skilful use of hypnotism (which is, of course, artificial somnambulism) the natural somnambulism is destroyed, rather unexpectedly perhaps. It might be expected that the production of somnambulism artificially would only intensify the somnambulistic tendency already present, but this need not necessarily be so. The person who walks in his sleep is easily hypnotized, and under hypnosis one may put him through the experience again, and after appropriate suggestion he wakes up remembering the circumstances in which he walked in his sleep, with the result that the subsidiary tendency in his mind has become reassociated with his main consciousness, and falls under its sway once more. In such patients, after one or two treatments, the somnambulism may be completely cured. In hysterical fits the patient is readily hypnotized, and under hypnosis a fit can be artificially provoked, and the psychological concomitants of the fit can be discovered. It can be ascertained what shock in his past life, or what set of incidents, have caused the fit, and been repeated in this automatic way again and again. The emotional tendency is worked off and reassociated with the main consciousness or the main personal self, and once again falls under its sway and the patient is cured. In amnesias, or loss of memory for definite stretches of past experience, containing incidents that had been disturbing to the patient, and had been in conflict with his main personality, one may recall such memories under hypnosis, and reassociate the mind. The consequent reintegration of personality means a higher

level of mental activity, and is a protection against further lapses of this nature. This method of hypnotic suggestion may thus be used not only to clear up the symptoms but to diminish the hysterical tendency, which is at the base of the symptoms.

There are alternative methods of dealing with hysteria. One is to analyse the patient's mind in much greater detail, without the use of hypnotism or suggestion, and this is the better method. It may often be very lengthy, and in some cases it is more convenient to combine the two methods—clearing up the symptoms by hypnotic suggestion, making certain discoveries of past events through hypnotic analysis, and by further general analysis working over the mind to diminish the patient's morbid susceptibilities and to reintegrate him and produce a more normal outlook and attitude toward life.

In the general case of psychasthenia hypnotizability is conspicuous by its absence. These patients are not hypnotizable, in the sense of being capable of falling into the state of artificial somnambulism. They suffer from a general feeling of incompleteness which needs help on the conscious level by encouragement, mental training, and rest, both mental and physical, to enable them to increase their general fund of mental energy, and to raise the level of psychological tension. A general re-education may be needful, whereby they are dissuaded from continually butting their heads against a blank wall of impossibility as regards their obsession or compulsion.

But here again, the more thoroughgoing method is the method of analysis, to discover the past and present psychological causes of the patient's illness. This method of analysis is capable of different degrees of thoroughness. In its simplest form it is a general psychological investigation of his past life and present difficulties. The analysis is of the nature of arm-chair

conversation, in which the patient talks out his life, and one intervenes from time to time with questions and suggestions to help his own interpretation of his past, and one guides him where he seems to fail to appreciate the real significance of some incident or other in his past, or the extent to which his own reaction at the time was inadequate and unsatisfactory. One also encourages him to scrutinize closely his present mental situation, his troubles and difficulties, his ambitions, hopes and fears, and to submit them to detailed analysis, and relate them to earlier memories and mental tendencies. Furthermore, one may help him to build up a general philosophy of life, in relation to his own individual case, using the Socratic method rather than that of dogmatic instruction. This general psychological analysis, which I have called *autognosis*, may not require many hours' treatment, but the patient gains immensely therefrom. The symptoms become more intelligible to him, and it may then be found that the more automatic part of the symptoms may be diminished by formal suggestion treatment in the subwaking state. The patient is asked to lie on a couch, with voluntary muscles relaxed, and to concentrate on sleep, avoiding effort while doing so. The physician then makes suggestions in a firm tone of voice, suggestions of a general nature as regards the patient's health, and of a special nature as regards the various symptoms from which he is suffering, on the basis of what has been discovered in the preceding psychological analysis.

A more thoroughgoing form of analysis is the now well-known method of psycho-analysis, which as a method is intimately associated with the *theory* of psycho-analysis developed by Professor Freud, according to which all these nervous symptoms are to be explained in terms of disturbance in the development and manifestation of the sex instinct, taken in the widest sense of the

term. This theory we can leave aside for the present. We may not discover sufficient evidence to constrain us to accept the theory in its entirety. Although we do find in certain cases that sex factors of a more or less general nature play a pronounced part in the causation of mental illness, we must admit that in many cases the sex instinct may seem to be little, if at all, disturbed, and the patient's difficulties may arise more directly from disturbance in other instinctive tendencies in the course of life, especially in the instinct of self-assertion, and the instinct of self-preservation and escape. These instinctive tendencies with their appropriate emotions may, in various ways, have given the patient great difficulty in the past, and the actual experience of the patient's life in relation to these instincts may involve maladaptation which the patient has subsequently attempted to correct by other reactions. So that we may find that what is apparent in the conscious mind of the patient is sometimes almost the exact opposite of what is discovered by deep analysis among the more primitive tendencies and earlier memories.

There are other general methods of treatment in the early stages of mental disease which should be mentioned. There is the method of isolation, whether partial or complete, the plan of segregation in a special hospital, or the mere separation from relatives for the purpose of diminishing the strain of social life upon the patient's mind. Social life involves its own special demand and strain upon mental activity. Adaptations to society are of great complexity, and seem to take up a great deal of mental energy, sometimes more mental energy than the patient can afford, and in this case it is important to diminish the expenditure of mental energy at once by removing him from his social *milieu* and giving him a rest. Treatment in mental hospitals has its advantages as well as its disadvantages. Its disadvantages are that it may unduly emphasize the

patient's illness and give him as companions people themselves ill, and that through imitation of these others he may find it more difficult to get better. All these objections sound more serious in theory than they are found to be in practice. Among the advantages are the well-regulated life and the greatly reduced demands on the patient, so that he is enabled to store up reserves of mental energy in an atmosphere of cure, knowing that other patients have received great benefit.

Personally, I find there is a very large number of patients who are able to continue their work while receiving treatment, who do not need to go into hospital, to whom continuation of work is really a help, not only financially but therapeutically, and under these conditions are able to afford a much more lengthy course of treatment, and benefit accordingly. The ideal method is the deep analytic method, but unfortunately it is impossible in every case. A mental home is needed when the patient is too troublesome in his own home and may be a danger to himself and others. In cases of excitability and of great depression a home is essential.

Besides these more specific mental methods of treatment there are certain physical methods, which may be classed as psychotherapeutical methods, since they are devised for their mental effect upon the patient. One such method is that of isolation already mentioned. Dejerine has applied this method to the treatment of hysterical patients. In his clinic isolation was often made as complete as possible. A curtain was drawn round the patient's bed, and he was allowed to see no one but the doctor. Another subsidiary method of treatment is, that during the first fortnight of this isolation treatment the patient is put upon a milk diet.

The rest cure has its antithesis in a work cure advocated by some doctors, but the work cure is obviously only applicable in special cases, and where the work is

congenial and does not make too large demands upon the patient's energy it should be very effective. Pottery painting, mat weaving, chair-making, carpentry, metal work, etc., have been found very helpful to certain types of patients. Simple mental exercises are also helpful.

Massage and relaxation exercises are sometimes important, and still more important are active exercises, such as riding, golf, tennis, and other games of skill, which can be a great help in getting patients back to the normal. There are some lethargic patients who will not make any effort, and suffer from not developing sufficient energy, and in these cases stimulation is needed in one form or another. Cases on the verge of severe depression, where the tendency is to sit still and do nothing, are sometimes greatly helped if they take up riding, a stimulant that can raise the psychological tension sufficiently to take them out of themselves.

It is quite obvious that these diverse methods, many of which seem to be contrary in their results, should be recommended with discretion. Different methods are applicable to different cases, and to the same case in different stages of illness. The practical thing in psychotherapy is, to a great extent, skill in the choice of means. Where skill can be specially shown is in the careful choice of means for the same patient at different times. This is not a matter of routine, it cannot be described satisfactorily in a set of written instructions, but it is gradually acquired by the physician in the course of practice.

Some Views of an Artist upon the Profession of Medicine.

By HENRY TONKS, F.R.C.S.
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I WOKE up in 1914, like Rip Van Winkle after his long sleep, to find myself back in a life I had left twenty-five years before. At first I wandered about in fear lest I should be expected to do work I had either forgotten or never known, and it was only the extreme consideration of my newly-found brethren in medicine that succeeded in giving me courage. After I had become somewhat calmer I began to look about me and to observe how the new medicine was related to the old, and the results of my observation are now noted down in THE PRACTITIONER for what they are worth.

There are many older men than I am in the profession, but few probably who have separated themselves from its practice for so long a time. I began my medical studies in 1879, going straight from a public school to a county hospital as a pupil, a course unknown at the present day, so that I immediately began practising medicine in some form, either by visiting the wards, helping among the patients, attending the casualties in the surgery (which was also the operating-room), or pulling out teeth—the first one, unhappily for the patient, was the wrong one. I remained as a pupil for more than eighteen months, and I am sure that that time was medically as valuable as any that came after, as I was at once brought in contact with the living human side of my work. Perhaps it was from my earliest impressions being so essentially practical

that I felt a certain disappointment on re-entering the profession, which I did by going to a great hospital to see if I could pick up a few scraps to help me to be of some use in the war.

It seemed to me that men were relying less upon themselves and more upon information they obtained from someone else by means of machines or processes away from the patient, thereby infecting the student with the idea that disease and injury were not to be discovered by the gifts of sight, touch, and hearing, but rather by the use of elaborate machines and analyses. In fact, in medicine, as in every other walk of life, man was coming under the wheels of the machine and neglecting to cultivate his own sensibility.

As an artist this was to me a painful discovery, but of no general interest if the whole change was to the advantage of the patient. Beyond a doubt the discovery of the X-rays, the much greater use of the bacteriological and chemical laboratory and the microscope are all to the advantage of the patient, but does not the student thereby get led away from properly developing his own faculties?

Medicine never has been and never will be a pure science; it is much nearer an art than a science. The facts of science can be transmitted, whereas art can only transmit its results; its ways of producing its results are individual, often unknown to the producer, unknown in the sense that he cannot explain them, but which are the very essence of his proceedings. Artists work by using the results of long-stored-up memories, brought out as if by magic at the right moment, and this is what is known as imagination.

In my young days in medicine the machines were few, so we had to rely on our eyes, our hands, and our hearing to solve most of our problems, and by doing this day in and day out we acquired an extreme skill in diagnosis without even moving from the bedside. Now,

the first visit of the doctor is merely preliminary to calling in specialists from every quarter before he can express any opinion, and this very wish to be thorough may lead him to miss a disease which an old physician would have seen staring him in the face.

Side by side with the study of man in disease must go the study of man in ease, and it is just here that the doctor might learn something from the practical artist. Does the medical student learn as much about man as he might? Does he really know his anatomy? What anatomist has ever known his muscles as Michelangelo knew them? We are possessed with the study of the corpse. What is less like a living being than those emaciated half-dried-up things known as subjects? We must always have them by us for reference and examination, but still more should the student have before him the living model. We learn our anatomy, or did at least, by a series of dissections, which must of necessity give an almost two-dimensional view of the body, and I remember that it was only some time after actually demonstrating anatomy that something of the real understanding of the solidity of the body came to me, when I had a better opportunity of exploring the sort of "no man's land" between the various dissections. Of course, all the facts are stated in the books, but a real grasp of things is seldom got out of books. Unquestionably without the aid of a sculptor the eminent surgeons and dentists engaged in repairing the mangled faces of the war would not have made the progress they did; they were always willing to acknowledge and to put into practice his suggestions. He, much more than a doctor, had been obliged to understand the relation of things from many different points of view, and thereby had obtained a better sense of solidity. Is the medical student made to understand the movements of the body?—perhaps the very first lesson he should have, which could be given with enough

anatomy thrown in to make any ignorant but intelligent person understand them in a general way in three-quarters of an hour.

A grasp of the movements of the human body is the gate to the study of man. By his movements in the absence of speech, or with it, he expresses his emotions. The most ordinary pose of even a professional model seems to me to be related to some mood, and unless an artist has an understanding of this relation he will never be able to depict human beings properly, or understand them. By understanding the movements of the human body a student comes to see the importance of the curves of the spine, and be brought to a sense of its beauty, and, perhaps, be made to wonder at our skill in preserving the upright position upon so small a pedestal.

I do not remember, when I began the study of anatomy, anybody speaking of the beauty of the human body. Perhaps my teachers had not noticed it. We had, when I was a student, something called surface anatomy—not a happy term, but it always seemed a kind of afterthought. I should like the living model always to be near the dissecting-room, so that everything that was discovered in the subject could be at once related to a properly-formed man and considered from different points of view, with the changes brought about by movement.

I believe, then, that anatomy might be made part of the knowledge of a doctor, not something which he can never rely upon, and which is apt to leave him in a most embarrassing manner. The visual memory is the more usual memory; indeed, it is essential for an anatomist, and the very fact of seeing something first in the dissection, and then immediately related to the model, will imprint it upon his mind in an enduring manner. Beside its value in actual anatomy the student would gain much from constantly having before him

specimens of the healthy body. It would remind him of the importance of the preservation of health, which must be the ultimate end of medicine, and which enlightened men in and out of the profession are calling for more and more. The slight changes which take place in the movements and general aspect of a man at the beginning of disease have already been made the subject of inquiry, and to discover them we must be very familiar with the perfectly sound human body.

It would be no bad thing if an artist were part of the staff of every hospital; apart from his use as a recorder of all sorts of disease, far superior to the photographer from his power of eliminating the unessential, his powers of observation and his personality might be used in other ways. Without being able or even wishing to formulate exactly how, I feel that the comments of a man whose whole life is spent in the very closest observation possible might act as a stimulus to both doctors and students, and remind them of the human side of their profession. In all kinds of plastic surgery he is undoubtedly necessary, and not without his value in the treatment of fracture. My experience of artists has taught me that the good ones are not dreamers, but essentially practical, inventive, and full of resource.

The whole trend of education at the present time is towards substituting the school for the workshop. It is the outcome of our belief in examinations and their rewards in diplomas and degrees. No examination, even in my time, was a true test of the knowledge of the man, and as a means of finding the better men it was ridiculous. Even the nurse to-day must have her college and pass examinations in anatomy, physiology, and other learning. The good nurse, like the good artist or the good doctor, is good because she has a vocation, and no diploma will add to her value. I have discovered that there is even a diploma in swimming, so that instructors of swimming can be produced

who understand the *theory* of swimming, and I feel sure that soon jockeys will be obliged to pass an examination in comparative anatomy.

We have all felt in the medical profession the weight lifted from our minds when we had done with examinations, and could seriously begin to learn our profession, whereas, with no examinations ahead, a student could be really learning it from the beginning. The good men are soon found out by the staff and their fellow students. Let doctors fight against instead of encouraging the dragooning of society by the machine, whether it takes the form of an attempt to standardize the human mind by multiplying examinations, or by encouraging the belief that any kind of instrument is going to take the place of human experience and human powers of observation. Science he must call to his aid, but it must be a tool in his hand and not a machine whirling him along faster than his judgment. Science itself is now telling us that we are naturally far more instinctive than logical; very well, let us make the best use of our qualities. We are men, not gods or machines, so that to cure the ills of man we must develop our highest man qualities, and in helping the young, who will finally take our places, we must give them no false impressions, but must make it clear to them at the start that all that they finally produce comes from their own tending of the seed which God planted in them.

Cardiospasm, or Achalasia of the Œsophagus.

By F. HOLT DIGGLE, F.R.C.S.

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ACHALASIA is a term applied by Hurst to an interesting and puzzling condition of the œsophagus which has recently received much attention. It is characterized by an obstruction, during life, situated at the lower end of the œsophagus, with hypertrophy of the œsophageal wall above, but without any apparent cause as seen after death.

It was first described by Hannay in 1833, who regarded it as an idiopathic dilatation of the œsophagus, since no organic lesion could be found. Mikulicz, in 1882, considered that the obstruction was due to simple spasm at the cardiac orifice, and hence the name "Cardiospasm" was, and still is, applied to the affection. As, however, the condition may exist for years, and no hypertrophy of the cardiac sphincter develop, it would appear that the condition is not due to spasm. Further, since spasm of the pylorus in infants will, in a few weeks, produce marked hypertrophy of the pyloric sphincter, it is reasonable to presume that a spasm at the cardia, existing for years, should produce a similar hypertrophy.

Morell Mackenzie[1] considered that it was due to "diminished contractile power or general weakness of the œsophageal musculature," but this does not explain the consistent hypertrophy of the œsophageal wall above the obstruction. The absence of any

hypertrophy of the cardiac sphincter, together with the presence of hypertrophy of the muscular coat of the œsophagus, led Rolleston[2] to suggest that the dilatation of the œsophagus might be due to "a failure in the co-ordinating mechanism by which the cardiac sphincter is relaxed during swallowing," and he suggested that "paralysis or continual inhibition of the longitudinal muscular fibres of the œsophagus would allow dilatation of the tube to occur, and at the same time, by interfering with the opening of the cardiac sphincter, would induce hypertrophy of the circular muscular coat."

Later, Hurst, working independently, came to the same conclusions, and considered that the obstruction was not due to spasm, but to a "want of relaxation" of the sphincter as the normal peristaltic wave travelled down the œsophagus. The absence of any hypertrophy of the cardiac sphincter, either during life or after death, together with the fact that a mercury-filled tube often readily passes through the obstruction into the stomach, and can easily be withdrawn without any sensation of its being gripped, are the reasons upon which Hurst bases his theory. Other observers, however, are not in agreement.

Brown Kelly[3] maintains that definite spasm at the lower end, with hypertrophy of the cardiac sphincter, has been seen after death, and that all the endoscopic appearances are in favour of spasm. He considers "that this spasm is predisposed to by a state of irritability of the muscle fibres, or of the nerves mechanically controlling them in the wall of the œsophagus above the hiatus." Certainly the appearance of the lower end of the œsophagus by endoscopic examination is very like that of spasm. As the end of the œsophagoscope approaches the hiatal opening (opening through the diaphragm) there is seen to be a

puckering together of the orifice, which increases as the œsophagoscope is passed onwards. When the end of the œsophagoscope comes against the hiatal orifice, quite definite resistance is frequently encountered, but usually, after pressure has been kept up for a few seconds, the tube will gradually slide into the stomach. In some cases, however, the tube will not enter the stomach. This was so in the case of a patient, aged thirty-five years, whose symptoms had existed for four years. I was unable to enter the stomach even after exerting as much pressure as I thought wise. It would seem, therefore, that there are varying degrees of this affection at the lower œsophageal opening. In the majority the obstruction, whatever it may be, is so slight as to be overcome readily by pressure, whereas in others this is impossible.

Any ulceration at the lower end of the dilated œsophagus, due to the stagnation of contents, may reflexly excite spasm of the lower sphincter, and thus considerably increase the resistance to the passage of food or the œsophagoscope. There is also one feature of pathological and clinical interest—I refer to the occasional association of achalasia (or cardiospasm) with a gastric or, perhaps more commonly, a duodenal ulcer. I have personal experience of one such case, in which symptoms of achalasia were associated with typical severe duodenal pain. Laparotomy revealed a duodenal ulcer. Unfortunately the patient could not be traced after the operation, so I was unable to ascertain whether the achalasia was improved.

Morley, at a meeting of the Manchester Pathological Society, showed a specimen of achalasia, associated with a perforated duodenal ulcer. Two points of interest were emphasized, first, that the house surgeon had mistaken foul vomitus from a dilated œsophagus for that of fæcal vomiting, and, secondly, that at the autopsy no

hypertrophy or other abnormality of the hiatal œsophagus could be seen.

Jefferson, in a private communication, informs me that he has seen two cases of achalasia associated with symptoms of duodenal ulcer. In one the duodenal ulcer was discovered, but the other, a recent case of a young man of twenty-four years of age, was of special interest. Jefferson, believing that he was dealing with a duodenal ulceration, explored the abdomen; to his surprise no ulcer or scarring was discovered, but there was a very definite tight constriction at both the pyloric and cardiac orifices. A finger could, with difficulty, be invaginated into the abdominal œsophagus, and the nodular firm sensation was very suggestive of malignant disease of the abdominal œsophagus.

The X-ray appearances, after taking a bismuth meal, are characteristic: the marked dilatation of the œsophagus above the constriction is obvious, whilst the rounded lower end of the shadow cast by the bismuth distinguishes the condition from obstruction due to malignant disease. It is further noted that the shadow ends blindly at the level of the œsophageal opening in the diaphragm, and not at the cardiac orifice of the stomach. This observation led Chevalier Jackson to name the condition "Phrenospasm." He considered that the symptoms and signs were due to spasm of the diaphragm.

Douglas, at the Ancoats Hospital some three years ago, in a case of achalasia, blocked the right phrenic nerve with alcohol. A complete paralysis of the right half of the diaphragm resulted, but with no amelioration of the symptoms. Recovery of the diaphragmatic movements took place six months later, and the patient remained *in statu quo*.

Woodburn Morrison informs me that two right and two left phrenic nerves have thus been separately treated without any definite improvement. I think

this goes to show that neither the diaphragm nor the crura of the diaphragm play any part in the pathology.

SYMPTOMS.

Achalasia may occur at any age, though it is more frequently seen in patients under forty years of age. There does not appear to be any predilection for either sex. The condition develops gradually without any apparent cause, though one of my cases definitely dated the onset of her symptoms to a severe attack of influenza. Rolleston records a case of achalasia developing in a boy after an attack of whooping-cough. At first the symptoms are intermittent. The patient frequently describes the obstruction as being in the upper part of the epigastrium, though occasionally the sensation may be referred to the upper border of the sternum. The onset and sequence of the symptoms can best be described in the words of an intelligent lady, twenty-four years of age, who recently consulted me:—

She dated her symptoms from an attack of influenza five years previously, and said: "At first I thought that I was suffering from indigestion. I had pain at the pit of the stomach and a choking sensation after eating. Vomiting commenced three years ago. When the food reaches the lower end of the gullet I feel a choking sensation, and occasionally I vomit very forcibly. At times the vomit comes through the nose and is ejected far into the room. There is no pain at all now, but a feeling as if the stomach is full. I am breathless for about ten minutes after taking a meal. I have to drink one pint of warm tea at the close of each meal to get the food along. It has to be a full pint and must be warm. If I drink fluids before eating the food returns immediately. Occasionally the food comes back when I am asleep."

The above description of symptoms is the same as is met with in most cases. There are, however, one or two points which perhaps require special emphasis. First, the relief of symptoms with the imbibition of large quantities of water. I have frequently noted that warm water will relieve the obstruction, whilst cold water increases the symptoms and may produce

pain. Further, it must not only be warm, but it must be copious. This fact would seem to show that the condition is not one of spasm, but a "want of relaxation," and that the added weight of a large volume of water causes the hiatal opening to dilate. The second feature of the above case is the onset with symptoms of indigestion. Is it possible that in some cases the onset of achalasia is due to the incidence of an œsophageal peptic ulceration—a rare type of ulcer occurring at the lower end of the œsophagus first described, in 1839, by Albers? Pain in the epigastrium with a choking sensation and dysphagia are typical features of such an ulceration.

Not infrequently fluids are swallowed more easily than solids, and in spite of the apparent shortage of food the patient maintains, after an initial loss, a standard weight. Often patients will relieve their discomfort by voluntarily bringing up the major portion of the meal. Occasionally the vomiting reflex has to be stimulated by tickling the fauces.

DIAGNOSIS.

The history of the case and description of the symptoms are usually so characteristic that little doubt exists. The same symptoms and X-ray findings may, however, occasionally be associated with carcinoma at the cardiac orifice. The intermittent and variable nature of the dysphagia in early cases, and the long duration of symptoms in cases not previously diagnosed, are strong presumptive evidence in favour of achalasia. The age of the patient, in my experience, is not of much value, as cases of malignant disease of the cardia not uncommonly occur in young persons. An œsophagoscopic examination usually settles the diagnosis.

TREATMENT.

Various devices have been invented for dilating the

hiatal opening. Plummer uses a water dilator. It consists of a bag, which, having been passed through the hiatal opening, is filled with water until the patient experiences pain. This dilatation has to be frequently repeated, and is, I think, a method little adopted in this country. The mercury-filled œsophageal bougie of Hurst is frequently employed, and is a useful instrument. This bougie, by virtue of its own weight, readily slips down the œsophagus, and usually passes into the stomach. The patient at first swallows it just before each meal, but in time the tube may only be required once a day, or even once a week. The tube is kept in position for a few minutes and then withdrawn, and should not project more than an inch into the stomach, for fear of setting up gastritis. To prevent this, the bougie is marked at levels of 16 inches and 17 inches from its lower end. As, however, occasionally the end of the bougie will not engage in the hiatal opening, but curl up in a dilated œsophagus, it is important to verify its position by X-ray examination before adopting treatment by this method. The ordinary gum-elastic bougie rarely engages in the lower end of the œsophagus, and is usually only of service in dilating, under vision, a resistant sphincter prior to using the mercury tube. The patient should at all times eat slowly, with thorough mastication, and the value of a copious draught of warm water has already been stated.

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[1] Morell Mackenzie: "Diseases of the Throat and Nose," 1884.
[2] Rolleston: *Trans. Path. Soc. Lond.*, 1896, xlvii, p. 37.
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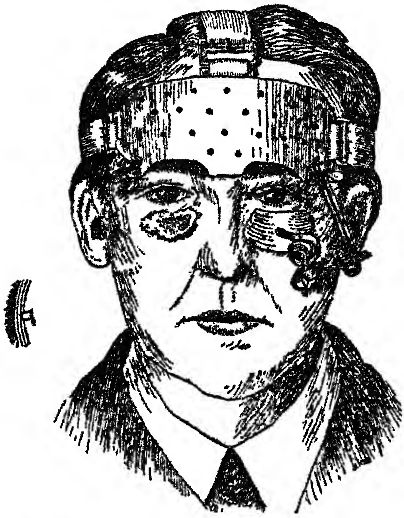
The Extended Use of the Whole Thickness Skin Graft.

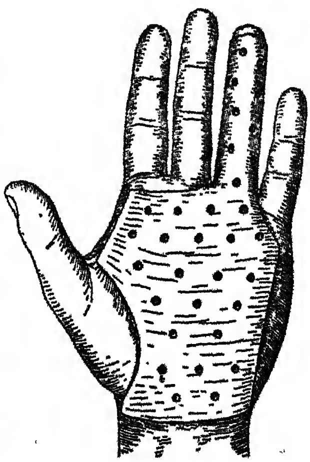
By PERCIVAL P. COLE, M.B., Ch.B., F.R.C.S., L.D.S.R.C.S.

Surgeon to the Cancer Hospital, Seamen's Hospital, Greenwich, and Queen Mary's Hospital for the East End; late Hunterian Professor, Royal College of Surgeons.

EXPERIENCE has shown that the Wolfe graft is capable of steadily increasing application. Its superiority to the Thiersch in plastic surgery, particularly in exposed parts of the body, is so defined as to justify the expenditure of considerable trouble and the exercise of persevering ingenuity in endeavours to extend its scope. In situations such as the forehead presenting firm resistant surfaces that make easy the maintenance of firm steady pressure, the Wolfe graft has given consistently good results. In other parts of the face raw areas in soft parts constantly subjected to slight movement are not so easily dealt with. Particularly is this the case in the loose yielding tissue in and around the neighbourhood of the lower lids, an area prone to be affected by rodent ulcer. Many methods have been tried, but they are defective in one way or another, either on the score of discomfort, lack of elasticity, or difficult access to the area concerned. To meet the difficulties encountered in the excision of rodent ulcer from this part of the face, the apparatus figured has been evolved. The broad metal forehead piece is lined with Stent's modelling compound, and ensures a large, firm, accurately fitting bearing surface. A small piece of soft metal is cut to the shape and size of the incised area and bent to the contour of



the part. On its upper surface a circular depression is made with a punch designed for the purpose. When the graft has been sewn into place, the under surface is covered with a small quantity of hot soft Stent and gently pressed home over the area involved. The arms of the apparatus are then so arranged that the little knob on the terminal spring arm fits snugly into the depression on the upper surface of the little piece of metal. In this way light constant pressure is maintained with the least discomfort to the patient, and the maximum of accessibility. The results obtained by excising rodent ulcers, and covering immediately the raw area with a Wolfe graft, have shown that the method is practically and cosmetically reliable, and that recurrence need not be feared in early cases if a sufficiently wide margin of apparently healthy tissue be included in the excised area.



A further use to which I have successfully put the whole thickness skin graft is in the case of cicatricial contractions producing flexion deformities of the fingers. In this type of case a good result may confidently be expected provided one or both long flexors are intact. When the scar tissue has been excised and the fingers straightened, a raw surface of

roughly diamond shape will be left. A graft of the required shape and size is cut and sewn accurately in the defect. A perforated zinc splint (see figure), shaped for the particular case, is filled with soft Stent, gently pressed home, trimmed as may be required, and bandaged in position. The results obtained have exceeded all anticipations, and have resulted, in many cases of machinery accident, in the restoration to good use of fingers recommended for amputation. The method is applicable to congenital conditions, such as webbed fingers, acquired deformities such as Dupuytren's contracture, and traumatic and septic conditions such as may follow accidents, septic infection, and burns.

A brief account of a recent case will demonstrate the utility of the method:

Nurse D., referred to me in July, 1925. As the result of severe septic infection her right thumb was bound down by scar tissue, and occupied a flexed and adducted position with the atrophied terminal phalange flexed at a right angle. She was just at the beginning of her training, and the disability occasioned was so marked as to threaten her career. An X-Ray photograph showed the joints to be practically normal. At operation the scar tissue was removed and the thumb was eventually reduced to occupy the position of extreme abduction and extension. When this was done there existed a large, raw, roughly quadrilateral area extending to the interphalangeal joint and straddling the interosseous space, which had been obliterated by scar tissue. A Wolfe graft of the size and shape of this raw area was cut from the thigh and sewed accurately to the margins of the denuded area, covering in the long flexor tendon of the thumb. The hand and thumb were bandaged to a splint specially adapted and of the nature figured. Progress was more or less uneventful, except that a small area of the graft on the palmar surface sloughed, and healing was somewhat delayed. The movements of thumb are now good, the interosseous interval has been reconstituted, she can wield a tennis-racket, has good apposition, but is hampered in finer movements by loss of sensation which was present before operation. She will certainly be able to continue her training.

The Analgesic Effects of X-Rays in Cancer and Other Painful Disorders.

By FRANCIS HERNAMAN-JOHNSON, M.D.
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MUCH has been written concerning the power of X-rays to control, if not to cure, cancer; and in current writings there is manifest a certain tendency to put radiotherapy and surgery against one another, as though they were rival treatments. This seems a mistake, for the one is a physiological, the other a mechanical remedy; and neither is likely of itself to prove a wholly adequate weapon. The controversy has, however, had the bad effect of distracting attention from the relief of pain and discomfort in cases where it is admitted that no known method can hold out any hope even of temporary "cure."

The milder kinds of pain in malignant disease may be controlled by aspirin and drugs of an allied nature; for the more serious distress there is only morphine. Its disadvantages are many—both psychological and physical. As to the former, it is difficult to give the drug to an intelligent patient without his guessing what is being administered, and consequently assuming that his case is hopeless. Some patients object to being rendered "dozy," and others, again, "on principle," refuse to be "kept under the influence of a narcotic." On the physical side, gastric upset and constipation result, and there is the necessity for almost daily increase of dose. Add to these drawbacks

the fact that in some cases no dose which it is practicable to administer will control the pain, and it is evident that morphine, despite its remarkable properties, is far from being an ideal analgesic, even in conditions where ultimate recovery is not expected.

On the other hand, judicious X-ray treatment will keep the majority of cancer patients practically free from pain until at most a few weeks from the end. Other symptoms such as hæmorrhage and discharge are, when present, often mitigated, and the patient, being aware of the reputation of rays as agents capable of controlling malignant disease for long periods, does not look upon advice to undergo such treatment as merely a counsel of despair. Even if it is desired to conceal the nature of the malady from him, no difficulty arises, as the public is becoming increasingly aware of the value of radiation in non-malignant conditions, such as idiopathic uterine hæmorrhage, bleeding myomata, and Graves' disease.

The degree of actual control which can be obtained by X-rays differs very much in various forms of cancer; their power to mitigate pain is, however, less dependent upon the particular nature of a malignant growth. For example, there is no class of case in which the prognosis is less favourable than in cancer about the mouth and throat; yet complete relief from pain may be obtained, together with deodorization, even in advanced cases.

Case 1.—Mr. M., aged 56, was sent to me in September, 1924, suffering from recurrent cancer of the jaw. There was a three years' history, during which there had been several operations, but he had had no previous X-ray treatment. There were wounds discharging externally, and ulcerated surfaces within the mouth, the smell from which was most offensive. He was in great pain, and weak from frequent hæmorrhages. X-ray treatment was administered on four successive days, a modified form of intensive therapy being employed. The pain vanished, and hæmorrhage ceased by the end of a week; the smell became hardly noticeable. This patient lived another seven months, during the first two of which he improved in weight and strength. Later, there was increasing discomfort due to

salivation and gradual closing of the throat, but he never again suffered actual pain—any sign of a return of this being at once checked by further X-ray treatment.

This case was treated by high voltage X-rays, because cancer in the region of the jaw and throat seems to respond best to a hard radiation. The capacity to relieve pain is not, however, peculiar to X-rays of the type produced by modern apparatus, such as has come into prominence within the past few years.

Case 2.—In the year 1912 I was asked to see a patient, a Quaker lady, who was dying from a painful form of peritoneal cancer. She refused, on religious grounds, to be kept under the influence of morphia, yet her sufferings were so great that she could not control the expression of them, and greatly distressed all those about her. She was much too ill to be brought to my rooms for treatment, and a portable plant was set up in her bedroom. The quantity of X-rays available was very small, but daily doses of about half an hour's duration were given, at first, a three-millimetre aluminium filter being interposed. By the end of a week the pain was nearly gone, and from that time until her death, a month later, the patient remained comfortable.

The presence of extensive swelling of the arm and shoulder is not necessarily any bar to the success of X-rays as analgesics. The following case illustrates this fact:

Case 3.—Miss M., a woman about forty years of age, was sent to me in July, 1923. She had extensive cancer of both breasts—the right much retracted and firmly fixed to the ribs. She had been in great pain for some weeks, and only when this became unbearable did she consult a doctor. As a result of X-ray treatment the growth on both sides shrank considerably, and pain ceased. She received another course of treatment three months later, and there was a further shrinkage. Things went well till February, 1924, when, quite suddenly, the right breast, right arm, and right side of the face swelled in an alarming manner, and this was accompanied by great distress. She came to see me again, and although I saw it was impossible to save her life I gave her a heavy X-ray dosage. She returned home, and a month later was sinking fast; but *had had no return of pain*.

No hard-and-fast rules can be laid down for the administration of X-rays for analgesic purposes. The small dose two or three times a week usually does well, and has the advantage that it cannot, even tem-

porarily, lower the patient's vitality. But concentration may succeed where fractional dosage fails; and, apart from this, the administration of a course within a few days has advantages where patients come from a long distance, or are immersed in affairs, as the good effects last for two or three months.

Apart from their effect on pain, X-rays may relieve various minor discomforts associated with malignant disease. Although the word "minor" is legitimately used in medical descriptions, the complaints so designated are often regarded seriously enough by patients —who, it should be remembered, frequently do not know the real nature of the malady from which they are suffering, and, therefore, lack our standards of comparison.

That X-rays are often effective as deodorants I have previously mentioned (see Case 1). They may also cause the drying up of troublesome discharges, which can render miserable the life of a patient, even if he has no pain.

Case 4.—Mr. G. P. had a colostomy done in 1923 for cancer of the rectum. He was kept in ignorance of the nature of his disease. The operation freed him from pain, and, by means of a daily enema, he was enabled to determine the time of evacuation of the bowels. He could fish and play golf. The surgical intervention may, therefore, be said to have been very successful—but the patient was unhappy. He complained of a blood-stained slimy discharge, which persistently oozed both from the lower opening of the colostomy wound and from the anus. He consulted a local surgeon, who advised him to try X-rays. Unconvinced, he wrote to the surgeon in London who had operated on him, and asked his opinion. In reply he received a letter urging him not to submit to radiation treatment, "which could do him no good, and quite possibly might make him worse." The patient, therefore, gave up the idea for some weeks, but increasing discomfort finally led him to disregard the great man's advice, and he came up to see me. He was given a semi-intensive course lasting a week, at the end of which time the discharge was rather less. He then returned to the country. After four weeks he wrote to say he was much better. I heard no more about him till, six months later, his wife called to see me. Her husband, she told me, had recently died, but whether from malignant metastases or from heart failure is not certain. She informed me, however, that during the last months of his life he had been comfort-

able in body and contented in mind, the discharge having practically disappeared.

In considering the use of physical remedies for the relief of pain in cancer, one must not lose sight of the value of diathermy and synthetic sunlight. Where pain following operation for breast cancer—with or without swollen arm—is not relieved by X-rays, diathermy should be given a trial. Where there is general physical and mental depression, treatment of the whole body by a combination of lamps, so arranged that the longer rays of the spectrum are present as well as the ultra-violet, is often of great value. The patient improves in health and spirits, and *pari passu* with this improvement the pain usually lessens. Even if the lessening of pain is not directly accomplished, the patient is brought into such a condition that he responds to further X-ray treatment, although it may previously have been ineffective.

Just as the use of the above means ought not to be forgotten when dealing with painful cancer, so the value of X-rays as analgesics should be borne in mind in the case of certain afflictions where electricity is generally the first resort. In obstinate sciatica, in neuralgia following herpes, in the girdle pains of tabes, in fact, wherever there is persistent pain not dependent upon shut-in sepsis, X-rays—though not, of course, always successful—are worthy of a trial.

Case 5.—A. M., a man of 55, suffered from a severe attack of shingles affecting half the face and scalp. After the subsidence of the attack, pain of a severe neuralgic type remained, and was unrelieved two years later. A doctor, whom he met casually, suggested X-rays, but his family physician would not hear of this, and for some months succeeded in dissuading him. Finally he sought other advice, and was sent to me. X-ray treatment banished the pain in six weeks, and it had not returned a year later. (It should be mentioned that "ionization" and high frequency had previously been applied without success.) The patient meanwhile had resumed the outdoor life which appealed to him, and from which he had been barred for nearly three years.

The reluctance of some practitioners to permit their

patients to undergo X-ray treatment is, I think, due to a fear, conscious or sub-conscious, that injury may result. The massive doses of the Erlangen school—which never found general acceptance among the radiologists of this country—may, indeed, be harmful, both locally and constitutionally. X-rays applied solely for the relief of pain or discomfort need never even approach a dosage which is dangerous. The remarkable effect of very small doses—an effect which is in essence neither depressing nor stimulating, but *regulating*—is well seen in ductless gland disorders, notably in exophthalmic goitre; and it is often possible with amounts equally small to control the pain of cancer. Such treatment may be continued for months with the production of nothing worse than slight temporary browning of the skin. It is, however, usually preferable to employ somewhat larger doses for a few weeks at a time. Doubtless there is still some element of danger even in a modified form of intensive therapy; but, if small doses have failed, it is justifiable to use it when a palliative effect alone is aimed at. It may relieve the pain, despite the failure of minor measures, and, in some cases, apparently hopeless, may even cause general improvement for a time.

In concluding this brief account of the pain-relieving properties of X-rays, I should like to point out that they share these properties with other forms of radiation. Radiant heat and ultra-violet light are both powerful analgesics. The relief of pain by heat is so well known a phenomenon that it is accepted as a matter of course, and excites neither incredulity nor wonder. It is generally "explained" by stating that the benefit is due to dilatation of surface capillaries. X-rays also produce capillary dilatation, though not of an obvious type. In neither instance is the explanation adequate, nor is the clinical result either more or less mysterious in the one case than in the other.

The Treatment of Splenomedullary Leukæmia by Deep X-Ray Therapy (Erlangen Method).

By JOHN GRACIE, M.B., F.R.F.P.S.
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THE treatment of leukæmia has always been a matter of difficulty, as, though various remedies have been stated to give satisfactory results, the improvement in the condition of the patient would appear to coincide with the remissions, which are often a common feature of the disease. It is, however, generally recognized that marked improvement takes place after X-ray treatment, and this form of treatment, either alone, or with arsenic, is now generally adopted. With the introduction of deep X-ray therapy, it occurred to me that it might be used with advantage in the treatment of splenomedullary leukæmia, and after consultation with Dr. Riddell, of the X-ray department of the Western Infirmary, we agreed that a case which was then under my care in the infirmary should be treated by this method. The following is a report of the case :—

M. W., female, age 46, was admitted to hospital on July 3, 1922, complaining of pain in the abdomen and of great weakness.

History of present illness.—Two months ago she felt occasional pangs of severe pain below the left costal margin. This was followed by attacks of sickness and vomiting. She became progressively weaker and lost flesh.

Personal and family history.—She suffered from measles in childhood, and influenza in 1918. She is married, and has three children, who are alive and well. There is nothing in her family history to suggest either syphilis or tubercle.

Condition on admission.—Her general condition is poor, and she has evidently lost weight. There is marked pallor. There are no subcutaneous hæmorrhages, and there is no enlargement of the superficial lymphatic glands. She is edentulous. The mucous membrane and tongue show marked pallor. The tonsils are not enlarged. The abdomen is protuberant, and on palpation a large, hard, smooth, and definitely notched mass is felt occupying the whole of the left side of the abdomen from the left costal margin to the pelvis, and extending to 1½ in. to the right of the middle line. The liver is not palpable. The pulse rate is 88 per minute. It is regular in force and rhythm and of low tension. The area of cardiac dullness is slightly enlarged. The heart sounds are pure, but of poor quality. There is no abnormality in the respiratory, nervous, or genito-urinary systems.

Blood Examination.

Red cells	3,600,000	Leucocytes	60,000 per cm.
Hæmoglobin	48 per cent.	Colour index	·6

Differential Count.

	Per cent.		Per cent.
Eosinophils	6	Hyaline	7
Neutrophils	55	Nucleated reds (megalocytes)	1
Basophils	0·5	Transitional cells	5
Large lymphocytes	12	Mast cells	2
Small ,,	12		

On July 17 she had one 100 per cent. dose of deep X-ray treatment (Erlangen method) over the spleen, area 15 by 10 cm. Distance, 35 cm.; filter, 5 mm. zinc. There was no rise of temperature after the treatment, and she felt no immediate after-effects. The improvement which followed was very marked. The sense of exhaustion soon disappeared, and from being lethargic she became alert and active; even when the leucocyte count fell to 2,000 she felt quite well. The spleen began to diminish in size almost immediately, and when she was discharged from hospital on October 3, 1922, it was not palpable below the costal margin.

Blood Count.

Date.	R.B.C.	Leucocytes.	H.B. Per cent.	C.I.
20. 7.22	3,700,000	37,000	40	·5
24. 7.22	3,100,000	29,000	38	·6
30. 7.22	3,790,000	27,000	34	·4
9. 8.22	4,125,000	10,400	36	·4
16. 8.22	5,056,000	8,400	42	·4
23. 8.22	3,488,000	6,200	48	·7
30. 8.22	3,500,000	2,300	44	·6
6. 9.22	3,710,000	4,200	56	·7
13. 9.22	4,900,000	3,400	62	·6
4.10.22	4,820,000	4,400	64	·6

Date.	R.B.C.	Leucocytes.	H.B. Per cent.	C.I.
11.10.22	5,120,000	6,560	65	·6
18.10.22	6,000,000	6,400	70	·5
10. 3.23	5,780,000	25,000	91	·8
13. 4.23	3,410,000	25,000	30	·4

She remained well until January, 1924, when she noticed that she had difficulty in undertaking her household duties. She became progressively weaker, and she suffered from breathlessness and loss of appetite. In February she had an attack of hæmatemesis, and she noticed that her stools were dark in colour. She had severe epistaxis four times during the month. She also suffered from vomiting, and she noticed that her spleen had become enlarged. When readmitted to hospital on March 19, 1924, the lower border of the spleen was 1½ in. above Poupart's ligament

Blood Count and Treatment.

Date.	R.B.C.	Leucocytes.	H.B. Per cent.	C.I.
19.3.24	4,310,000	198,000	64	·7
26.3.24.	One 75 per cent. dose over spleen area 15 × 10 cm. Distance, 35 cm.			
31.3.24	3,400,000	110,000	58	·8
3.4.24	3,510,000	96,000	65	·9
14.4.24	4,700,000	42,000	65	·6
5.5.24	4,500,000	24,600	68	·7
12.5.24	One 80 per cent. dose over spleen (front) area 15×10 cm.			
	One 80 „ „ „ „ (back) „ 15×10 cm.			
13.5.24	4,258,000	19,200	70	·8
19.5.24	4,200,000	9,000	73	·8
3.6.24	5,360,000	11,400	72	·7
12.6.24	4,230,000	14,500	75	·8
23.6.24	One 50 per cent. dose over spleen (back) area 15×10 cm.			
27.6.24	5,660,000	35,000	80	·7
30.6.24	5,500,000	25,500	78	·7

The improvement in general health was again very marked during her stay in hospital, and she gained 7 lb. in weight. When discharged on June 30, 1924, the spleen was palpable below the costal margin. After her discharge from hospital she remained well until the middle of August when she began to feel weak. She had a slight epistaxis, and, later, diarrhœa with blood in her stools. She noticed that her spleen had become enlarged.

She was again admitted to hospital on September 4, 1924. Pallor was not a marked feature on this occasion. She suffered from diarrhœa, which continued for four days after admission, but no malæna. The lower border of the spleen was 2 in. above Poupart's ligament.

Blood Examination.

Red cells - -	5,200,000	Leucocytes - -	156,000
Hæmoglobin -	62 per cent.	Colour index - -	·6

Films show numerous whites, myolocytes, neutrophil, basophil, and eosinophil leucocytes, and some megaloblasts.

Date.	Blood Count. R.B.C.	Leucocytes.	H.B. Per cent.	C.I.
15. 9.24	4,280,000	113,850	75	·8
26. 9.24	4,700,000	83,700	80	·8
6.10.24	One 70 per cent. dose over spleen (front) area 15×10 cm. Distance, 35 cm. One 70 per cent. dose over spleen (back) area 15×10 cm. Distance, 35 cm.			
9.10.24	2,980,000	37,600	65	1·0
28.10.24	Discharged, much improved. Patient able to go about without undue fatigue. Leucocytes number 11,800.			

Deep X-ray Therapy (Out-patient).

17.11.24 One 50 per cent. dose over right thigh area 15×10 cm.
,, 50 ,, ,, ,, left ,, ,, 15×10 cm.
Leucocyte count, 12,800.

1.12.24 One 60 per cent. dose over right shin area 15×10 cm.
,, 60 ,, ,, ,, left ,, ,, 15×10 cm.
One 30 per cent. dose over right shoulder area 15×10 cm.
,, 30 ,, ,, ,, left ,, ,, 15×10 cm.
Leucocyte count, 13,500.

13.3.25 Leucocyte count, 30,000. Spleen just palpable under costal margin. Patient feels very well.

A few cases of splenomedullary leukæmia are stated to recover, but the large majority of cases run a chronic and progressive course, terminating fatally in two to three years. The foregoing case is of interest in that it is now over three years since she first received treatment, and with the exception of two relapses she has continued in good health and been able to carry on her household duties. It is interesting to note that the most marked improvement resulted from one 100 per cent. dose, and that the first relapse in her condition did not occur until two years later. The subsequent dosage was decided on as a result of the severe drop in the number of leucocytes, which occurred after her first treatment. The response to further treatment by smaller doses was neither so rapid nor so pronounced, while the subsequent increase in the leucocyte count took place earlier.

The result of treatment as observed in this case has been much more satisfactory than that obtained by ordinary X-ray methods, and a single maximum dose is, in my opinion, more satisfactory than repeated smaller doses.

Local Anæsthesia in General Practice.

By W. QUARRY WOOD, M.D., Ch.M., F.R.C.S
Assistant Surgeon, Edinburgh Royal Infirmary.

THE question of anæsthesia is one which affects every medical man. It is now fully recognized that the efficient administration of a general anæsthetic is an art, and requires for its performance one who has served a faithful and prolonged apprenticeship. In general practice, especially in the more remote parts of the country, it is not always easy to find one who is so qualified. Apart from the risk to life of unskilled administration, general anæsthesia is apt to be followed by considerable discomfort from sickness, and exposes the patient to the dangers of bronchitis and other pulmonary complications, and of delayed poisoning. There are two classes of case commonly met with in ordinary practice where a general anæsthetic must be regarded as unjustifiable; the first consists of most minor surgical affections, the second of certain abdominal emergencies, which, under special conditions, the practitioner may be compelled to deal with himself. With regard to minor surgical operations, there are few of these that cannot be performed painlessly and efficiently under local anæsthesia, and it becomes the duty of the practitioner at least to allow the patient to make his own choice after the circumstances have been fully explained to him. It is impossible to say that any general anæsthetic is safe; indeed, the tragedies of general anæsthesia appear to occur not infrequently where it has been given for comparatively trivial conditions. On the other hand, it is possible to say that local anæsthesia,

administered with reasonable care, is entirely free from danger.

The second group of cases, namely, certain urgent abdominal conditions, are usually handed over to the surgeon, but in distant parts of the country the practitioner may be compelled to operate on these himself. In patients who are dangerously ill—exhausted by prolonged vomiting in intestinal obstruction or enfeebled as a result of cardiac, pulmonary, or renal disease—the administration of a general anæsthetic will often in itself be fatal. These cases can be dealt with in an extremely satisfactory way under local anæsthesia: an enterostomy can be performed to relieve an obstruction, strangulation of a hernia can be relieved, and many other life-saving measures can be readily carried out without distress to the patient, and without adding to the heavy handicap under which he already labours.

Why is local anæsthesia not more frequently employed in general practice? One reason is probably the belief that a highly-specialized armamentarium is required. Another explanation in some cases is a failure to obtain satisfactory anæsthesia, either owing to some mistake in the method of administration or from attempting to use the method in unsuitable cases. If the limitations of the method are recognized, it can be employed in general practice for a considerable variety of conditions, and with great satisfaction to both doctor and patient—provided that certain rules are carefully observed. The apparatus required is of the simplest character, and involves a very small outlay.

It is well, perhaps, to consider the limitations first. The method requires the co-operation of the patient, and unless this can be secured, it is a mistake to proceed. The patient will feel the initial prick with a fine needle and, although this, in reality, produces little or no pain, in certain subjects the apprehension which

already exists causes a reaction out of all proportion to the injury inflicted. If there should be any further pain produced due to some slight failure in technique, the result will be most unsatisfactory. If, on the other hand, the co-operation of the patient can be obtained, the needle-prick is ignored, and the operation proceeds smoothly and comfortably. The temperament of the surgeon plays an important part in attaining a successful result, equal, perhaps, to that dependent on the psychological condition of the patient.

Local anæsthesia fails entirely in an inflamed area. An attempt to infiltrate such a hyperæmic and œdematous region will increase the tension in the part, and will cause intense pain, with the risk of sloughing of the tissues injected. The method should never be used in acute sepsis.

Speaking generally, it may be said that the method is unsuitable for intra-abdominal operations. The abdominal wall can be anæsthetized perfectly, but manipulation of the viscera is liable to cause pain. The pain is due, not to the presence of sensory nerves in the viscera themselves, but to traction on the highly-sensitized parietal peritoneum, through the mesenteric or other visceral attachments. If the intra-abdominal manipulations can be reduced to a minimum, as in gastrostomy or cæcostomy, the method can be used with success.

We may consider next the conditions in which local anæsthesia is especially indicated, and in which it may be easily carried out. Of minor surgical affections in which the method is particularly suitable, mention may be made of small tumours and cysts, amputations of fingers and toes, hæmorrhoids, circumcision in the adult, hammer-toe, hallux valgus, and skin-grafting, though a great many other conditions might be added to the list. In the second group of cases mentioned above—patients dangerously ill, and in whom a general

anæsthetic is contra-indicated—the value of local anæsthesia cannot be over-estimated. Intestinal obstruction is one of the most dangerous of emergency conditions, and is associated with a very high mortality; if the patient is in a critical state it is much wiser to limit the operative procedure to a simple enterostomy under local anæsthesia than to attempt any extensive exploration. In strangulated hernia the strangulation can be relieved, if need be, under local anæsthesia, and the radical cure performed painlessly; resection of the bowel can be carried out without great discomfort, if care is taken to avoid unnecessary traction on the mesentery. The writer has resected over seven feet of small intestine under local anæsthesia in a case of strangulated umbilical hernia. Of other operations in which the method is satisfactory, one would refer especially to acute empyema—in which condition the lungs are often recovering from a pneumonia, and not in a state to withstand the irritation of a general anæsthetic—tracheotomy, cerebral decompression, and suprapubic cystotomy.

The technique of local anæsthesia is simple, the necessary outfit is limited in quantity, easily prepared, and very cheap, so that the method is admirably suited for use in general practice. The apparatus required consists of a syringe, two sizes of needle, novocaine tabloids, adrenalin solution, a spirit lamp and stand, and a four-ounce measuring glass. An ordinary record syringe of 10 c.c. capacity serves admirably. One needle should be 1 in. in length and fine; the other should be 3 in. If the larger needle is of stainless steel it can be used repeatedly, and does not become clogged. The fine needle should only be used once, as it is essential that it should be perfectly sharp. Syringe and needles can be sterilized by immersion for ten minutes in a solution of 1 in 20 carbolic acid. Novocaine is decomposed by contact with an alkali, so that it is

absolutely essential that no alkaline substance, such as lysol, should come into contact with syringe, needles, or novocaine solution. Novocaine tabloids, to make a ·5 per cent. solution when dissolved in distilled water, can be readily obtained. The solution must be boiled before use, and for this purpose a suitable glass vessel, a small stand, and a spirit lamp are required. Novocaine is not harmed by boiling, and the solution should be boiled for at least five minutes. The adrenalin chloride solution (1 : 1,000) should then be added in the proportion of three or four drops to the ounce of novocaine solution, and the solution again brought to the boiling-point. Adrenalin is decomposed by boiling for any length of time, and it is quite sufficient to treat it in this way. Adrenalin forms a valuable addition to the anæsthetic solution, since by its vaso-constrictor action it delays the absorption of the novocaine and prolongs the anæsthesia.

The injection is nearly always made by the *infiltration* method. In this method the tissues to be operated upon are flooded with the anæsthetic solution. The secret of success consists in using plenty of the solution and infiltrating the field of operation thoroughly. In making the first injection the skin should be pinched up between the finger and thumb, and the fine needle inserted with a quick thrust. If the needle is sharp this prick is almost painless. A wheal is produced by injection of the skin, and the needle then pushed on to its full length, the fluid being injected as the needle advances. From this starting point the long needle can be introduced into the deeper tissues without pain. As wide an area as possible is infiltrated from the one puncture. The needle can then be withdrawn and introduced at a fresh point, which has already been rendered analgesic. Very often the procedure can be planned so that the patient feels only the initial prick. It is usually advisable to anæsthetize the skin at the

site of each successive puncture by causing the needle to enter it from its deep surface in making the preceding injection. The periosteum and the parietal peritoneum are highly sensitized, and must be infiltrated with special care. In the case of the latter structure, if the operator is not certain that he has reached it from the surface, he should make a fresh injection when the extra-peritoneal fat has been exposed.

The *regional* method of producing local anæsthesia has a very limited application in general practice. It consists in anæsthetizing the nerves supplying the field of operation by injecting the novocaine solution either into, or immediately around, the nerve trunks. It can be conveniently applied to operations on the fingers or toes. A zone of infiltration carried around the root of a finger or on each side of the base of a metatarsal will give complete anæsthesia of the digit. By this method amputations and the hallux valgus and hammer-toe operations are conveniently carried out. The ulnar nerve may be injected at the elbow for operations on the medial side of the hand, but injection of other large nerves should not be attempted in the circumstances under discussion.

It is advisable to wait for five minutes or so in order to give the anæsthetic time to produce its full effect. Certain details of technique in the operative procedure require special mention. It is of the first importance that all manipulations should be carried out as gently as possible. It is obvious that the effect of pulling or of blunt dissection may extend beyond the anæsthetized area, and produce discomfort in the surrounding parts. Every care must be employed to secure complete hæmostasis, since after the constricting effect of the adrenalin wears off there is a possibility of reactionary hæmorrhage. Perfect asepsis is, of course, essential, although infection does not appear any more liable to occur with a local than with a general anæsthetic.

Practical Notes.

Treatment of Asthma.

M. Sédillot insists, in the treatment of asthma, on the importance of the diet: no meat, no eggs, no salt, no wine, no coffee, no stimulants, but a milk and vegetarian dietary. After four weeks a little meat (once a day) and salt may be added to the diet. M. Sédillot does not advise any of the antianaphylactic methods. Except at the asthmatic crisis adrenaline should only be used exceptionally. He prescribes iodine (0·60 to 1·80 grams—10 to 25 grains—per day), and, while fasting, sulphate of soda (5 grams —75 grains—in the morning) or calomel (0·05 grams—1 grain). The adrenaline may be given at the crisis in hypodermic injection, along with the following:

℞	Heroin - - - - -	0·002 gram ($\frac{1}{30}$ grain).
	Atropine sulphate - - -	0·0002 gram ($\frac{1}{300}$ grain).
	Distilled water - - - -	1 c.cm.

—(*Journal des Praticiens*, February 13, 1926, p. 105.)

Treatment of Asthma in Children.

A. H. Rowe comes to the conclusion that many disturbances of the respiratory tract in childhood and young adult-life are due to anaphylactic phenomena (allergy). Asthma occurs frequently during these years and is often mistaken for bronchitis. Careful testing and re-testing with a large number of all classes of the proteins known to cause asthma have given positive reactions in 95 per cent. of Dr. Rowe's series of 110 patients. Asthma has been shown to be due to animal emanations, food and pollen proteins in a large percentage of these cases. Dr. Rowe especially emphasizes the importance of pollen sensitization as a cause of asthma in the first two decades of life. Surgical treatment in the nose and throat is contra-indicated in asthmatic patients except for the improvement of their general health. It is unnecessary to recommend a change of climate to control asthma. The treatment is usually complex, as nearly every patient has multiple sensitization at the basis of the asthma, and requires constant and watchful analysis by the medical practitioner as well as faithful and accurate co-operation by the patient. The best treatment for food sensitization is absolute exclusion of the offending substance or substances from the dietary. In cases of animal emanation sensitization the greatest care must be taken to remove all animal substances from the environment of the susceptible patient; this is especially necessary when the patient gets asthma from the inhalation of house dust. Pollen treatment must be with antigens made from specific pollens to which the patient is most sensitive. In certain patients vaccine treatment was used successfully; and in many asthmatic patients sunlight therapy has given

good results, through its increasing the general resistance.—(*American Journal of Diseases of Children*, January, 1926, p. 51.)

Treatment of Seasickness.

P. H. Desnoes notes, as among the suggested causes of seasickness, labyrinthine over-stimulation, "muscle-sense" disturbance, eye-strain, peripheral vagus nerve irritation, and psychic stimuli. In Dr. Desnoes's opinion all of these factors play some rôle in the causation of seasickness, and according to the individual susceptibility some factors are undoubtedly more prominent in one case than others. Immunity to the effects of a ship's motion under average weather conditions is usually established in a healthy adult after three or four days. In regard to treatment, the great majority of passengers can avoid seasickness by adopting, a week or so before sailing, a few rules of hygiene and diet. Abundant sleep must be obtained, to place the central nervous system in as good a functioning condition as possible. Open-air exercise, riding, and aquatic sports are recommended also. Proper bowel elimination should be achieved by exercise and diet, and if necessary by a laxative dose of sodium phosphate (2 drachms in 6 ozs. of water), taken one hour before breakfast, or phenolphthalein (1 to 2 grains) at night. The important objects in dieting are to establish a reduced hydrogen ion concentration in the blood, and to store up in the body plenty of buffer substances, because of the tendency to acidosis. After a person embarks, the diet generally should be restricted in amount; little fluid should be taken at meals. The mind should be kept actively engaged. Drugs of the belladonna group, combined with strychnine, are strongly recommended by many. Girard advocated the use of atropine 0·5 mg. ($\frac{1}{250}$ grain) with strychnine sulphate 1 mg. ($\frac{1}{60}$ grain), subcutaneously, at the beginning of a voyage, during rough weather, or on the advent of a storm. In Dr. Desnoes's experience better results are obtained with scopolamine hydrobromide, in small doses, frequently repeated—0·13 mg. ($\frac{1}{500}$ grain) scopolamine hydrobromide, by mouth, every hour until the patient is relieved. A simple and pleasant way of giving this is one teaspoonful every hour of a mixture containing scopolamine hydrobromide 1·3 mg. ($\frac{1}{50}$ grain), spirit of peppermint 0·2 c.cm. (3 minims), elixir of lactated pepsin sufficient to make 30 c.cm. (1 oz.). In cases with much depression, strychnine sulphate 1 mg. ($\frac{1}{60}$ grain) is added to the mixture.—(*Journal of the American Medica Association*, January 30, 1926, p. 319.)

Treatment of Leukæmia.

E. Sergent and R. Mignot recommend the use of X-rays in the treatment of myeloid leukæmia, and give particulars of a number of cases successfully treated. Deep X-ray treatment, at successive intervals, is apparently the best method to employ. In one case cited the general condition of the patient definitely improved after two exposures, the spleen becoming reduced in size, and the blood regaining the normal appearance. The sternum, ribs, vertebræ, and

long bones should be X-rayed as well as the spleen. Large doses of radium, applied to the spleen, have also given good results in the treatment of myeloid leukæmia, a number of patients who were severely ill having lived for several years after radium treatment.—(*Paris Médical*, December 5, 1925, p. 468.)

A Method of Softening Scar Tissue.

W. Stoeltzner has carried out a number of experiments with regard to the softening of scar tissue, employing, among other substances, thiosinamine, potassium, choline, and urea. He reports that the best results were obtained with a concentrated solution of urea, injected under non-adherent scars. It must, however, be used with caution, as it caused, in some cases, necrosis when injected under an adherent scar.—(*Münchener Medizinische Wochenschrift*, December 11, 1925, p. 2133.)

Treatment of Chronic Nasal Diphtheria.

A. Abraham points out that so-called ozæna may be in many cases chronic nasal diphtheria. He gives particulars of thirteen cases which (with one exception diagnosed as chronic rhino-pharyngitis sicca) were diagnosed as cases of atrophic rhinitis, but bacteriological examination revealed all of them as being chronic nasal diphtheria. Of these cases only two were stated to have had diphtheria. The cases were all treated by the injection for three days of 4,000 to 6,000 units of diphtheria anti-toxin, along with twelve to fourteen injections of an autogenous vaccine prepared from the nasal discharge, which contained other organisms as well as the diphtheria bacillus. Irrigations of the nose with $\frac{1}{4}$ per cent. chloramine solution were also carried out.—(*Deutsche Medizinische Wochenschrift*, December 18, 1925, p. 2114.)

Treatment of Bone and Joint Tuberculosis.

H. Keller notes that the consensus of opinion is that bone and joint tuberculosis are caused by a tuberculous focus located elsewhere in the body, which only through one cause or another finds the vicinity of the joint the most favourable medium for invasion and development. X-ray examination of the chest should always accompany the X-ray examination of the joints in tuberculous affections of the latter. Therapeutic measures directed towards curing the joints alone are only part of the treatment. Radiation of the chest should be tried in those cases where enlarged lymph nodes in the chest accompany the joint disease, as well as the other therapeutic measures which are ordinarily applied in cases of tuberculosis.—(*Medical Journal and Record* (New York), February 3, 1926, p. 169.)

Reviews of Books.

The Book of Prescriptions. By E. W. LUCAS and H. B. STEVENS. Eleventh edition. Pp. 382. London: J. and A. Churchill. 10s. 6d. net.

WE are under the impression that the first edition of this most useful book was published by John Churchill in 1854 and not in 1856, as stated on the reverse of the title-page of the copy under review. In any case, Henry Beasley's "Book of Prescriptions" continues an honourable and fertile career under its present editors. It is so well known to practitioners wherever the English tongue is spoken that it requires no description. The new edition is brought thoroughly up-to-date, and what was lacking in this respect in the last edition is now made good. Insulin and colloidal therapy are dealt with in a practical manner; the prescriptions given for the use of colloidal drugs are sure to be appreciated. Pains have been taken to clearly indicate all the B.P. and B.P.C. articles and preparations which come within the scope of the Dangerous Drugs Act. The work of the publishers has been carried out in the admirable manner which is customary to them. It is a valuable book for the prescriber's desk.

Pathology of Tumours. By PROFESSOR E. H. KETTLE. Second Edition. Demy 8vo. Pp. 285. London: H. K. Lewis & Co., Ltd. 12s. 6d. net.

WE welcome the second edition of this excellent work. The book is thoroughly well thought out, and planned for the teaching and instruction of students. It contains clearly and simply stated all the broad elements of a subject which is very difficult to classify, especially as our increased knowledge of tumour formation always leads to that indistinguishable borderline which lies between innocent and malignant tumours. The subject is further complicated by the presence of such tumours as the melanoma, endothelioma and cylindroma. The illustrations throughout the work are of a high order, aptly chosen to illustrate the subject matter, and amply cover the whole range of the subject. It is curious to find in a small book on pathology such an excellent summary of the treatment of tumours, and to read these four and a half pages would well repay anybody. The strictly local nature of the malignant tumour at its commencement is insisted upon, together with the advantages of really early operation before metastases have occurred. The objects of operation, the pros and cons of frozen section examination at the time of operation, are dealt with, and with the conclusions drawn we cordially agree. There is also a short section given to the experimental study of cancer, which has become so important and extensive as almost to require a specialist of its own to deal with it.

Preparations, Inventions, Etc.

ANGIOLYMPHE.

(London: Messrs. Chas. Zimmermann & Co., Ltd., 9 & 10 St. Mary-at-Hill, E.C.3.)

This preparation, which is for the treatment of tuberculosis, is entirely of vegetable origin, free from alkaloids and mineral matter, and without preservatives of any kind. It is sterile, stable, and non-toxic, and causes no reaction. Its effect is apparently so to modify the soil that it becomes untenable to the tubercle bacillus, without, however, having any direct effect on the organism. It is given by injections into the gluteal muscles. The preparation deserves to be given a thorough trial in suitable cases.

MEDICATED SOAPS.

(London: Vinolia Company, Limited, Lever House, Blackfriars, E.C.4.)

The medicated soaps submitted to us by the Vinolia Company comprise the following: "Baby Soap," in which the lather produced is very soft and soothing, due to the special base employed and to the addition of petrolatum before milling; "Carbolic Health Soap," a neutral soap containing a definite proportion of phenol; "Coal Tar Soap," a similar soap containing cresylic compounds with lanolin; "Medicated Cream Soap," containing boric acid, calamine, zinc oxide, and lanolin, incorporated with a bland base; "Sulphur Skin Soap," containing a definite proportion of colloidal sulphur. Samples of these soaps will be sent to members of the profession on application to the manufacturers, mentioning THE PRACTITIONER.

LARGE WATER BISCUITS.

(Glasgow and London: Messrs. Macfarlane, Lang & Co., Ltd.

We have received a box of the "Large Water Biscuits" manufactured by this well-known firm. The biscuits are crisp and of excellent flavour, and, in addition to their more ordinary uses, may be suggested for the dietary of invalids in whom bread causes flatulent dyspepsia.

THE CONSTANTA TRUSS.

(Liverpool: Messrs. Alexander & Fowler, 104 and 106 Pembroke Place.)

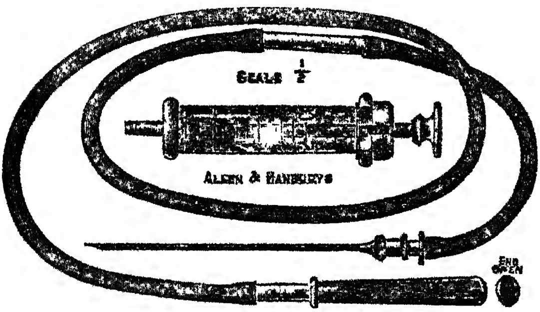
It is well known that if the hand be placed with the thumb on the inguinal ring after a hernia has been reduced, with the fingers round the pelvis in a line following the positions of a truss spring, the

most difficult hernia is controlled. The Constanta truss is an ingenious mechanical appliance, intended to act as efficiently as the human hand. The band is made of steel covered in soft material, and it does not compress tightly, the necessary pressure to hold the hernia being given by means of a spring working independently at the end of the band, and its position may be altered to give pressure on various points of the pad. This truss seems to be a distinctly useful appliance which eliminates most of the faults of other types.

A SIMPLE OUTFIT FOR PARACENTESIS THORACIS.

(London : Messrs. Allen & Hanburys, Ltd., 48 Wigmore Street, W.1.)

Dr. F. G. Crookshank has devised a simple outfit for paracentesis thoracis, which should prove very useful to many practitioners. It is a portable outfit, made up of a record syringe with assorted needles, for exploratory puncture of the chest, and is provided with an indiarubber tube and teat valve so mounted that evacuation, if judged necessary, can be performed immediately without withdrawing the needle and making another puncture with a trocar fitted to a complicated aspirator.



NEW PREPARATIONS.

(London : Messrs. Parke, Davis & Co., Beak Street, Regent Street, W.1.)

Bismuth Salicylate Suspension in Ampoules.—These ampoules each contain 2 grains of bismuth salicylate, suspended in pure olive oil, to which is added 10 per cent. of camphor and of creosote, which drugs tend to reduce pain or irritation at the site of an injection, in the treatment of syphilis by bismuth salts.

Metagen and Cod Liver Oil Emulsion.—Metagen is a physiologically tested preparation of the several vitamins of vegetable origin, and should be a valuable auxiliary to cod-liver oil, which does not contain all the vitamins.

Digifortis.—This is a physiologically standardized digitalis preparation, and, it is stated, every possible precaution has been taken to ensure its therapeutic efficiency, as digitalis preparations are notoriously liable to deteriorate. The average dose of digifortis is 8 minims, two or three times daily.

Tablets of Aspirin Compound with Dover Powder, Modified.—As the formula suggested in 1921 by Sir G. Archdall Reid comes within the scope of the Dangerous Drugs Act, these tablets have been introduced, containing rather less Dover powder (2 grains),

and more aspirin (6 grains), with phenacetin (2½ grains), so as to be outside the scope of the Act.

ISACEN.

(London: The Hoffmann-La Roche Chemical Works, Ltd., 7 and 8 Idol Lane, E.C.3.)

Isacen is a new synthetic, non-toxic purgative—diacetyl-dihydroxyphenyl-isatine, and is issued in small phials, each containing forty granules of 5 mgm. (1/13 grains) each. A dose of 2 to 4 granules is generally sufficient to produce stimulation of the mucous membrane of the large intestine, and in cases of mild constipation, one granule will produce a laxative effect. It is unaccompanied by intestinal pain or discomfort.

"THE BOTTLE AND GLASS CONTAINER BULLETIN."

(London: The United Glass Bottle Manufacturers, Ltd., 40-43 Norfolk Street, W.C.2.)

This "Bulletin" is a well-produced little publication, with an amusing cover in colours by Mr. G. E. Studdy. Among the bottles and containers illustrated in it are the U.G.B. medical bottle, the method adopted in the manufacture of which would seem to ensure extreme accuracy, and the U.G.B. tablet bottle, a type of bottle which should make the old-fashioned pill-box out of date.

SIL-AL.

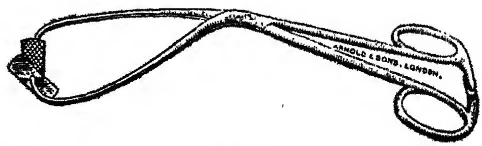
(London: Mr. Lionel Cooper, Pharmaceutical Agent, 41 Great Tower Street, E.C.3.)

Sil-Al is the name given to a preparation of aluminium silicate, physiologically pure. The specimen sent to us conforms to the usual tests, and may be prescribed with confidence where indicated. The usual dose is 60 to 90 grains, given in half a tumbler of water, before meals.

TONSIL COMPRESSION FORCEPS.

(London: Messrs. John Bell & Croyden, Ltd., incorporating Arnold & Sons, 50 Wigmore Street, W.1.)

Dr. C. D. Agassiz has invented an instrument designed primarily for use in enucleation of tonsils by the blunt guillotine. The square-ended blade is fitted with a small piece of rubber sponge, and a small gauze bag made with a purse-string thread at the neck is slipped over the sponge at the time of operation, and the thread pulled tight.



The other blade is covered with a piece of rubber tubing. The instrument is applied immediately after the enucleation of the tonsil—the sponge covered blade to the tonsil bed and the other blade behind the angle of the jaw. A clear field for the removal of the second tonsil is then left, and when both are applied, hæmorrhage is prevented. Two instruments, right and left, are required for each operation. In emergency, in case of secondary hæmorrhage, this instrument may also be useful.

THE PRACTITIONER

MAY
1926

Late and Early Carcinoma of the Breast.

By SIR G. LENTHAL CHEATLE, K.C.B., C.V.O., F.R.C.S.

Surgeon and Lecturer on Surgery, King's College Hospital; Member of Board, Royal Naval Medical Service; late Surgeon Rear-Admiral, Royal Navy, etc.

Part 2.

IN Part 1 (THE PRACTITIONER, April, 1926) I dealt with tumours of the breast that were, from their clinical signs, obviously carcinomata, even in those instances where no lymphatic glands in the axillæ were affected. This second part deals with the clinical signs which do not render a certain diagnosis of carcinoma possible, i.e. the carcinoma process has not spread to the same degree. Hence I shall now deal clinically with carcinoma of the breast in its earliest states. It is in such states that the surgeon has it in his power to cure a large proportion of his patients. Their diagnosis and treatment require the utmost care, consideration, and experience; and many patients pass from the operable stages to the inoperable for the want of these acquirements. I will make the attempt to indicate those particular

clinical signs to which great attention should be paid.

Class 1. A woman, about the age of forty years, healthy, has her attention called accidentally and without pain to a lump in her breast. The lump may be:

(*a*) Solid and comparatively hard, in which there is no suspicion of elasticity or fluctuation. It is not adherent to the skin, nor are there any enlarged glands in the axilla. It must be remembered, in estimating adherence of a tumour to the skin, that the breast is normally attached to the skin by the ligamenta suspensoria of Sir Astley Cooper. In the upper and outer quadrant of the breast, as it stretches towards the axilla, the normal gland is more attached to the skin than elsewhere. This hard, rounded, solid tumour slips about easily under the skin. On account of its complete roundness, it is probably a duct carcinoma. There is no reason why fibro-adenoma should not be present in a woman of this age. In fact, at least 30 per cent. of all breasts that contain carcinoma contain a fibro-adenoma. What makes the complete roundness of the tumour in a woman of this age so important is that it makes it possible to diagnose the tumour from a fibro-adenoma, which would be lobulated.

Treatment.—On the whole I should be inclined to advise complete removal of the breast as for carcinoma, the reason being that it is exceedingly dangerous to cut into a carcinomatous breast. Malignant epithelial cells are thus liberated into tissues into which they had not invaded.

(*b*) Rounded or lobulated, even adherent to the skin, but with the additional sign of being elastic or fluctuating. Hence, the observer may be dealing with a cyst or a soft fibro-adenoma or a carcinoma not purely of duct origin.

Treatment.—This type justifies a preliminary investi-

gation to determine the diagnosis. In conducting this investigation an elliptical skin incision should be made over the tumour; the external edges of the incision should be undercut and the quadrant of the breast in which the tumour is growing should be excised, and the resulting wound should be at once flooded and soaked with a 1 : 500 solution of perchloride of mercury. The wound should be covered over while the tumour is being examined. As a rule, a naked eye examination of the cut surfaces of a tumour can determine its nature. Should there be any doubt, the safest course of further examination is to obtain a microscopical section of the tumour together with that part of the breast in which it was growing. I am not one of those who believe in the safety of trusting the evidence of a frozen section cut, stained, and examined during an operation. Should the disease be determined as carcinoma, the complete operation for that disease should be performed.

Class 2. The discharge of blood with no other physical signs is spontaneous, and may be increased by pressure upon a certain part of the breast, either in the region of the ampulla or any other part of the gland. It is important to eliminate the possibility of trauma as a cause of the discharge. In such an event there is a definite history of injury that was followed by a discharge of blood from the nipple. The discharge gradually ceases and disappears at about the end of a fortnight.

Treatment.—In the absence of a history of trauma the whole breast and axillary and lymphatic glands should be excised as for carcinoma. The soundness of this advice requires explanation. It is true that a papilloma existing in an ampulla may be the only cause of hæmorrhage, and the only papilloma in the breast. On the other hand, when there is a papilloma

in an ampulla there are more often than not many papillomata existing in the whole course of its duct right down to and including a sessile epithelial hyperplasia in many of the acini with which it communicates. Although these papillomata and epithelial acinous growths may be completely encircled by normal boundaries, I regard this state as being dangerous, and I have found totally unsuspected carcinoma upon removing these breasts and in cutting whole sections of them for microscopical examination. Further, the breasts with hæmorrhage from the nipple may contain carcinoma arising in terminal ducts and acini, and in its earlier stages the only sign they evince is spontaneous hæmorrhage. Supposing the hæmorrhage to be induced only by traumatism, the nipple should be kept perfectly clean by washing it with boiled water, and a sterilized gauze dressing should be kept in contact with the nipple during the hæmorrhage, after which the injury may be assumed to have healed. Hæmorrhage from the nipple due to this cause is comparatively rare. I have met with three instances, and although careful inspection has been kept on these breasts they have remained free from further trouble for many years.

Class 3. I regard constant spontaneous discharge of only serum from the nipple as dangerous and always advise a complete removal of the breast for carcinoma. It is not a common sign. I have had five patients under my care.

In the first case I could find nothing in the breast by palpation. I advised the woman to keep her nipple clean by washing it with boiled water twice a day, and to dress the nipple with sterilized gauze. This treatment was adopted for six months, when I lost sight of her. When I heard of her again at the end of four years she had died from carcinoma of this breast.

The other four breasts contained in the terminal parts of a duct and its acini, in one portion of

the breast, an epithelial hyperplasia, which I have described as being dysgenetic in type, i.e. epithelial hyperplasia contained epithelial cells irregular in size, with nuclear hyperchromatosis and mitoses. In many of the affected ducts there was distinct papillomatous formation. Not one of these four patients had carcinomatous breasts, but they contained what I have described as being *the* pre-cancerous state. And although this state may, for some reason or other, remain latent or may disappear, yet should the process of epithelial hyperplasia continue carcinoma is its only termination.

Class 4. Localized lumpiness in one segment of the breast with no other physical signs is a state the diagnosis of which must be determined at once. Very commonly the terminal ducts and acini in one segment of the breast contain the dysgenetic epithelial hyperplasia I have just described as existing in breasts from which there is a discharge of serum from the nipple. The utmost care and judgment are required in the management of these clinical signs. Should there be the slightest suspicion of puckering of the skin, of rapid increase of size, I believe it is safer to remove the breast as for carcinoma upon the pathological evidence to which I have alluded. On the other hand, where localized lumpiness is the only sign, a localized removal for examination increases the danger of the patient if the subsequent discovery is made that the lumpiness is due to early carcinoma. Should a surgeon, from his experience, consider that he is not dealing with the dangerous states I have mentioned, he would be justified in removing the segment of the breast in which the lumpiness occurs, with all the precautions I have previously mentioned, and subjecting all the parts removed to a complete microscopical investigation. He would thus be enabled to advise the patient as to treatment on

evidence of which he is certain, rather than on an opinion only.

Class 5. Generalized small solid lumps or nodules in one breast or both breasts. It must be borne in mind that breasts enlarge and become lumpy at menstrual periods and during pregnancy and lactation. In the enlargement of the breast fresh acini form, and ducts become elongated to meet the requirements of the enlarging breasts. When the size of these breasts subsides some of the acini certainly atrophy, but the ducts, in order to accommodate themselves to the diminution in size of the breasts, become convoluted, the convolutions giving rise to a generalized solid lumpiness that is perfectly normal. Further, it is not at all uncommon for a layer of fat an inch and a half thick to supervene between the skin and the nearest part of the underlying gland, and yet these adipose breasts may feel lumpy. It is impossible to believe that through this thick layer of fat glandular elements can be felt. The lumpiness here is caused by the isolation of small fat lobules by the fibrous tissue that supports them.

That this occurs is well exemplified by a completely unnecessary operation that I performed on a woman who I thought had a very dilated ampulla. On exposing the part I found an enormous fat lobule isolated by a rather dense layer of fibrous tissue, which encircled it except on the surface. The ampulla was not dilated.

The fact that generalized lumpiness and nodularity occurs in perfectly normal breasts must always be borne in mind when attempting to form a diagnosis. In all doubtful cases the patient should be examined during and midway between her periods. Normal nodular breasts become painful only during periods. Should pain be persistent and bear no relation to periods, or become worse at the periods, there is something pathological occurring in the breast itself. The simplest cause of this condition is a generalized desquamative epithelial hyperplasia, which is occurring mainly in the

terminal parts of the ducts and their acini. The type of epithelial cells that have desquamated are as follows: they are all badly staining, irregular in shape, and desiccated.

Treatment.—The treatment of this state may be one of great difficulty and anxiety. I have known the condition to be temporarily relieved by supporting the gland, carrying the arm in a sling, by the application of hot fomentations, and by the exhibition of X-rays, the last being a form of treatment which I consider to be not altogether safe in the absence of complete knowledge concerning the action of these rays, which, in certain circumstances, can induce carcinoma. Finally, I have known the pain so bad and so constant, and borne by the patients for from eight to fifteen years, that it has induced them to seek relief by demanding the removal of the gland.

There is another type of desquamative epithelial hyperplasia that gives rise to lumpiness of breasts; it is not so generalized or so painful, and can exist without pain. It may be found in breasts after death, having given rise to no mammary pain. In this state the terminal parts of ducts and acini are also affected. The ducts are distended by a collection of large colostrum-like looking cells, with small central nuclei, and are seen in all stages of formation arising from the epithelium lining the ducts. The distension may be so great as occasionally to lead to extravasation of these cells through an interrupted duct wall into parts outside the ducts. Papillomata can be seen occasionally as additional complications to this state. In the acini the epithelium has changed into long, feathery, delicate cells which distend groups of acini. These changes in the ducts and acini are the chief causes of cystic breasts. The state is so quiet in development that it does not commonly induce clinical signs of sufficient intensity to attract the notice of the

patient. No treatment seems possible until cysts are formed and papillomata or other local complications have developed. Hence, it is a more serious state than the former. The clinical condition of the breast, on palpation, reveals intervening parts that are normal, thus differing from the completely generalized state I have just described.

Class 6. The state of generalized fluctuating lumps in one or both breasts is one of generalized cystic formations. Sometimes one large cyst is the only clinical evidence of it. The cyst is acinous in origin, and is due to the state of the acini above described, and many acini have become confluent to give rise to a large cyst. I have never examined a breast microscopically which contained a large cyst without finding innumerable smaller ones which the microscope alone was able to reveal, either in the neighbourhood of the large cyst or dispersed within the breast.

Treatment.—The treatment of cystic breasts is a difficult problem, and requires great courage on the part of the surgeon to advise what I believe to be the safest course to adopt, viz. removal. The amount of courage necessary to maintain my position is obvious when I say that surgeons of immaculate reputation aver with truth that they have never seen malignant disease arising in a cystic breast even after fifteen or twenty years of careful observation. All they believe that is necessary to be done is to tap the cysts which are giving discomfort, and to inject some fluid such as pure carbolic to eradicate them. They also feel themselves competent to say, after examination of the fluid and cellular contents and palpation of the surrounding parts, that no tumour complication exists in or around the cyst. I agree that breasts may be simply riddled with cysts the size of a walnut, and yet contain nothing in the least suspicious of any epithelial growth

inside, but I have had cystic breasts sent to me for microscopical examination of whole sections of them, and I have found foci of undoubted carcinoma which necessitated the removal of the glands in the axilla after an interval of two or three months—a disastrous state of things. Besides containing carcinoma these breasts have had papillomata in the terminal parts of their ducts. Further, I have five specimens of whole sections of breasts with large cysts which contained carcinoma. Some of these cysts had been tapped and treated in the manner I have described and reported on as being only cystic. I have evidence to show that the carcinoma in these large cysts began in the terminal ducts that led into them. The epithelium in these terminal ducts had not taken part in cystic formation, but was active and capable of responding to the effects of irritation to which the epithelial cells lining the cysts were so degenerated that they were incapable of response. My advice to remove all so-called cystic breasts is therefore an arguable one, but I feel sure that if the measures I advise were adopted, lives would be saved. If a practitioner were able to save only one patient in the course of his life it would be worth the sacrifice of all the breasts which contained no carcinoma. Reverting to the ordinary cystic breasts, the more I see of them the more convinced I am that my advice that they should be removed is correct. In considering the treatment of cysts, it must be realized that there are small cysts containing dysgenetic epithelial hyperplasia and affecting usually the terminal parts of one duct and its acini which are exceedingly dangerous. This state I have described under localized lumpiness.

Laxatives and Purgatives.

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THIS article in THE PRACTITIONER is chiefly addressed to those of my junior colleagues who have not had the opportunity of post-graduate hospital training, or of holding an assistantship after qualification.

A short time after qualifying I met an old and much respected practitioner, whose success was in no small measure due to the careful attention he paid to his patients' bowels; indeed, by an alteration of the initial letter in his name he was familiarly known as "Dr. Purge." During our conversation he remarked: "Look here, young man, take my advice—in treating your patients always remember to keep the kitchen clean." This advice, though full of wisdom, left the most appropriate methods for so doing to be discovered by observation and experience.

One soon found that the human organism was not merely an assemblage of standardized parts, but that the individuality of each patient was seen, not only in physical appearance, but also in the response of the internal organs to various foods, exposure to infection, effect of drugs, etc. Thus, irregular action of the bowels has to be treated in a manner applicable to the individual if the best results are to be obtained. Failure to recognize these truths was seen some years ago in a controversy on the question of the normal frequency of the action of the bowels; a well-known authority stated that the usual daily action was unnecessary, and that insistence upon it had become a fetish; others advised two actions daily. The fact is, that the normal in one

person is abnormal in another. In like manner the consistence of the excretion varies; in one perfectly healthy person it will resemble that of a dog, in others that of a cow.

For the purpose of this article it may be conceded that, generally speaking, a copious evacuation of a consistency not calling for excessive straining is the ideal one. The question then is, how is the ideal to be reached? Regular and efficient action of the bowels, like most good habits, calls for early and persistent training from the nursery period to adolescence. With children, especially, the common faults are over and too frequent feeding whereby the digestive organs do not get their proper rest. The old myth, "teething," is still with us, the truth being that teething is a natural and painless process provided the stomach is in a healthy state. Why do "teething powders" relieve the sick child? Simply by getting rid of irritating and unwholesome material. How often does one find the pain from a carious tooth relieved by a purgative!

In older children the temptation is to resist the call of nature if it interferes with games or other pleasures. If this thwarting of nature is persisted in the first step into the habit of depending upon aperients has been taken. The other salient points to be observed are:—

(1) Food appropriate to the child's age and constitution. The common reply among dispensary patients by the mother when asked what food she gives the child is: "The same as I has myself." This improper feeding accounts for fully half of children's ill-health; the giving of chocolate or other sweets at odd times, especially after being put to bed, is another cause of ill-health and carious teeth and bad temper.

(2) Hurried meals is a fruitful cause of constipation, general malnutrition, and, again, bad temper. This is true at all periods of life. I sometimes remind patients

that Nature has not provided the human species with a gizzard. The valuable habit of thorough mastication must be begun in the nursery and carried on well into adolescence. Too often a child is reproved by the mother or nurse for "always being last" over its meals, whereas he ought to be commended for it. This bolting of imperfectly masticated food is facilitated by copious draughts of fluid during the meal. By strictly limiting the amount of fluid taken during meals mastication becomes imperative since, unless the bolus is sufficiently softened by saliva, swallowing is impossible. The necessary amount of fluid can be taken well between meals whereby the contents of the bowels have sufficient moisture and the requirements of the body met. The inclusion of fresh fruit and vegetables in the daily menu is important, both for general nutrition, and as an aid to intestinal peristalsis.

(3) The importance of walking exercise at all ages is likely to be lost sight of with modern facilities for riding. There can, however, be no doubt of the value of walking in aiding the portal circulation and intestinal peristalsis.

In adults, especially after middle life, the possibility of malignant disease of the bowel being the cause of either constipation or diarrhœa should be always borne in mind. In the earlier stage of cancer the appearance of the patient does not suggest that disease, and it is just then that most benefit may be derived by operation.

I remember seeing in consultation a lady, 54 years of age, who had old-standing mitral disease. The object of the consultation was to decide whether, in the then condition of the patient's heart, it would be safe for her to take a long journey. On inquiring into the history and general health—a rule which should invariably be followed—it transpired that the bowels had been loose for some time and that occasionally

blood was seen with the motions. I was told these symptoms were of no consequence, as the patient had piles. Not being satisfied with that explanation a rectal examination was made, when advanced cancer of the rectum was discovered. Curiously enough, I had a similar experience with a male patient a fortnight later. Early in my career I was asked to see a lady 76 years of age for persistent diarrhœa, which had hitherto resisted treatment. So frequent were the actions that a diaper had to be worn. Rectal examination revealed a loaded rectum, the fæcal mass being so hard that it had to be broken up with the handle of a spoon and removed piecemeal. When a route for the passage of an enema tube had been made warm olive oil was injected and the rectum cleared. Laxatives were prescribed and the patient made a complete recovery. If these and similar mistakes are to be avoided the golden rule, "When in doubt examine the rectum," must be followed. It should be remembered that both constipation and looseness of the bowels may occur in connection with cancer of the rectum.

We have been considering the usual causes of constipation, its prevention by early training, judicious feeding, outdoor exercise, and the taking of fluid well between meals and only in extreme moderation with food. We will now inquire, given an aperient is needed, in what form it should be prescribed, always bearing in mind our goal—the restoration of natural action independent of the use of drugs. It is this which distinguishes a skilful doctor from the quack.

Aperients may roughly be classed as purgatives and laxatives. The former act mainly as irritants by stimulating the flow of mucus and increasing peristalsis of the bowel, the latter have a somewhat similar but more gentle and lasting action, which is favourable to the restoration of natural functioning of the bowels. The habitual use of strong purgatives is apt to clear

away good material along with the useless, to the lowering of the general nutrition. The too-effectual action of cathartics by keeping the lower bowel empty, and the purging habit formed, the stimulus to reflex action is removed. Salines, such as the sulphates of sodium and magnesium, though useful at times, are not applicable in cases where masses of scybale are present, since they are prone to cause only watery motions while the lumps may be left undisturbed. The stronger aperients, such as jalap, are often called for in cardiac dropsy by virtue of the watery motions they produce. Laxatives, on the other hand, are not open to the objections just referred to. Fortunately there are many such remedies available, alone or in combination with others, suitable to most cases, though the selection in individual instances will, at times, severely tax the medical attendant's therapeutic acumen.

The most reliable laxative is senna, alone or in combination with tartrate of sodium and carminatives. A formula in frequent use at the Royal General Dispensary during the present writer's pupilage there, was conf. piper nig. (B.P.), ½ oz., conf. sulphuris, 1 oz., conf. sennæ to 3 ozs.; one to two teaspoonfuls to be taken each night. Instructions were given that after a copious action sufficient to produce but one easy evacuation daily was to be taken. Infusion of senna pods is efficient and harmless. Cascara, with or without small doses of the extracts of nux vomica and belladonna, makes a useful pill in obstinate cases. Castor oil and petroleum are useful laxatives.

Congenital Hypertrophic Stenosis of the Pylorus.

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THERE is growing evidence to show that this condition, at one time considered rare, is of far more frequent occurrence than is generally imagined. Bardsley, as early as 1788, described a case of "Schirrus of the Pylorus in an Infant," and exactly a century later Hirschsprung gave us a clearer conception of the disease. Of later years it has received more liberal attention, especially at the hands of Thomson, Still, Cautley, and others. At the outset I would urge that the condition is badly named. "Pylorospasm of infants" is a term that far better meets the case. Pylorospasm of infants may be classified under the two following headings : (a) pylorospasm with excessive hypertrophy of the pyloric muscle; (b) pylorospasm with moderate or little hypertrophy of the pyloric muscle. Between these two headings will occur varying degrees of hypertrophy, and consequently corresponding variations in the symptoms.

PATHOLOGY.

In advanced and moderate degrees of hypertrophy, the pylorus is seen to be elongated, and enlarged in its transverse diameter. It is very hard to the touch, and the pyloric canal, in extreme cases, is practically occluded. Hypertrophy of the stomach musculature is pronounced, and especially that of the "pyloric antrum." Further, hypertrophy in many cases can

be observed in the musculature of the duodenum and jejunum.

Histologically, there is muscular hypertrophy, especially of the circular muscle, excess of fibrous tissue (in extreme cases), and in the vessels of the pylorus there is a varying degree of hypertrophic obliteration. These pathological phenomena are of significance in connection with the etiology of the condition.

CLINICAL FINDINGS.

Although fundamentally identical pathologically, yet groups (a) and (b) are clinically very different. It may be stated at once that the condition occurs almost exclusively in boy babies. It practically always occurs in the firstborn boy, though this is not a rigid rule, and it attacks almost invariably "the bonniest babies that one could wish to see." The most common period of onset of symptoms is from the tenth to the seventeenth day following birth, though in rare instances it may culminate as late as the tenth week.

A typical case of class (a) is the following :—

A.T., aged 16 days, a firstborn male child, was up to the tenth day a fine healthy baby. He weighed 9 lb. at birth. On the tenth day he started to vomit his feeds within a minute or two after taking them, the feed being shot out in projectile fashion. After this he would soon be hungry again, and would ravenously devour his next feed which would be returned as the former one. After the twelfth day constipation was practically absolute, and from the tenth day onward a rapid and progressive loss of weight occurred.

Here, then, we have a train of symptoms which should immediately arouse suspicion of this condition: a firstborn male baby, strong and healthy at birth, exhibiting on the tenth day vomiting of a projectile nature, constipation, and a very rapid loss of weight.

If a feed be given to such a baby, and the epigastrium be observed, peristaltic waves can be seen travelling from left to right until the feed is vomited back. Further palpation just to the right of, and above, the

umbilicus will reveal the presence of a hard tumour—the elongated and hypertrophied pylorus.

A typical case of class (b) is the following :—

N.P., aged 17 days, a firstborn healthy male baby, weighed 8½ lb. at birth. On the eleventh day he started to vomit part of his feeds, and under the impression that the mother's milk on which he was being fed did not agree with him, he was weaned. For 48 hours he was fed on diluted cow's milk which he kept down, but at the end of this time vomiting started anew. He was then fed on Benger's food, Nestlé's milk, Allenbury's food, and a host of others, but each was retained for a few hours only, when in turn it was vomited in projectile fashion. Loss of weight was gradual, and all of the stools consisted of undigested food. Visible peristalsis was observed as in class (a), but a pyloric tumour was discovered only with difficulty, and was certainly not always present (true pylorospasm).

Here is a different train of symptoms : vomiting of a more irregular kind but projectile, passage of undigested food, a more gradual loss of weight, visible epigastric peristalsis, and the inconstancy of a pyloric tumour.

ETIOLOGY.

What is the etiology of this serious condition? Certain theories have been put forward. John Thomson suggests that the pyloric hypertrophy is secondary to congenital gastric spasm, while Cautley is of opinion that the hypertrophy is primary and due to pyloric overgrowth. I think we must go further to seek for a more satisfactory explanation.

In cases grouped under class (a) there can be little doubt that the hypertrophy is ante-natal, and to a less extent the same must be said of class (b), for it is inconceivable that such hypertrophy could occur within ten days after birth. Further, these babies take their feeds, digest and thrive on them up to the onset of the vomiting. It is the additional element of spasm (pylorospasm) accompanied with gastrospasm and enterospasm on top of already hypertrophied structures that initiates the symptoms. This statement is substantiated clinically, specially in cases of class (b), for gastric lavage prior to leaving a small feed in the

stomach will often allay the spasm, and allow the feed to pass on. This treatment has also temporarily succeeded in two cases grouped under class (a). In every instance of gastric lavage a viscous material has been removed from the stomach, but beyond the fact that it is hyperacid, further investigation of it has not been carried out. Again, how common a complaint is pylorospasm in the adult male, and how rarely is it seen in females. Here it is said to be secondary to other causes, notably appendicular in origin. There can be little doubt that it is influenced by still further factors, notably excesses in tobacco, the presence in the stomach of certain foodstuffs, imperfect mastication of food, business worries, and others, to which the male is more exposed than the female, and it is undoubtedly the forerunner of duodenal ulcer, which is almost as much a man's lot as pylorospasm is that of a male baby. The old saying of midwives, that male babies are more difficult to rear than female, bears a big weight of significance. There is little doubt that the male gastro-intestinal tract is a much more irritable structure than that which obtains in the female. This would seem to be one of Nature's mistakes, because it is called upon to bear more insults than that of the female. It would be interesting to know what percentage of duodenal ulcers occurring in the male occur in the firstborn. I have searched the literature on the subject, but can find nothing relating to this. I think it is not going too far to suggest that the occurrence of pylorospasm in the newborn male will find its explanation in some unbalance of the endocrine system. Some slight excess of suprarenal or pituitary activity due to lack of inhibition acting over a prolonged period could account for the hypertrophy and irritability of the intestinal musculature. The more I acquaint myself with this disease the more am I convinced that pylorospasm is only part of a general condition of irritability affecting the whole of the intestinal tract.

DIAGNOSIS.

Diagnosis should not be difficult, yet so many of these babies are diagnosed as, and treated for, marasmus, inanition, etc. In fact, eight cases out of my series of 45 (that is, nearly 20 per cent.) were diagnosed in the medical ward, having been sent into hospital diagnosed as "wasting."

PROGNOSIS.

The prognosis is good provided the following obtain: (1) The baby is not below 5 lb. in weight. (2) The baby has not been weaned. (3) The treatment can be carried out in private.

(1) If below 5 lb. in weight, acidosis is present to such a grave degree that treatment of any kind is difficult and almost hopeless. (2) *The mother's milk is essential*, especially after operative treatment. This is a point the importance of which cannot too strongly be urged. (3) It is a noteworthy fact, and in accord with the findings of others, that the cases treated privately do infinitely better than those treated in the wards of a children's hospital.

TREATMENT.

This requires the most complete co-operation between surgeon and physician; cases grouped under class (a) are primarily surgical, and the operation of choice is undoubtedly Rammstedt's, for it is simple, quick, and involves the minimum of shock. The approach is through a one-inch incision made through the right rectus muscle, the pylorus is delivered, and its musculature divided down to the mucous membrane of the pyloric canal. The pylorus is then returned, and the abdominal wound closed by two or three through-and-through sutures of silkworm gut. This simple operation requires but a very few minutes for its execution. The anæsthetic employed has been a mixture of one part chloroform to eight parts ether.

For cases grouped under class (b), provided the loss

of weight is not pronounced, it is justifiable to temporize and to employ gastric lavage, leaving a small feed in the stomach. If the weight remains stationary, and specially should it show an increase, however small, lavage should be persisted with. If, however, the baby is losing weight on this treatment, operation should not be delayed. With gastric lavage, small doses of belladonna may be exhibited.

It is after operation that the resources of both physician and surgeon are most heavily taxed, and the whole problem is the finding of a suitable diet. The operation itself is but a very small part of the treatment, for it only relieves the pylorospasm; it does not correct the general intestinal irritability already referred to. The baby ceases to vomit and takes its feeds greedily, but the food is hurried along the intestinal tract and appears undigested in the stools, gain in weight too often does not occur, diarrhœa ensues, acidosis becomes extreme, and the baby dies.

The above is what is prone to happen in hospital cases. It has been suggested that ward infection is responsible for the occurrence of the post-operative diarrhœa with undigested stools. This may be so, as these emaciated babies are no doubt very receptive to any ward infection that may be present. Bacteriological examination of the stools has negatived this theory, and I think the explanation lies elsewhere.

It is a noteworthy fact that in all my cases treated in the municipal hospital, where the mother can be admitted with the baby and can feed it after operation with her own milk, there has never been a moment's anxiety, while cases treated in the children's hospital when the mother's milk has been taken with a breast pump at home and brought to the hospital have done well, but not so well as when the mother has been able to feed the child direct from the breast. In three cases we were able to get milk from a wet nurse. All three

cases recovered and did well, but they were not so satisfactory as those that had their own mother's milk. There is, then, strong presumptive evidence to show that the mother's milk is of paramount importance to the baby's welfare after operation.

The evidence in this direction is so strong that the following rule may be laid down: If a firstborn healthy male child starts to vomit its mother's milk any time from the tenth to the seventeenth day after birth, if the vomiting be projectile in character and associated with visible peristalsis in the epigastrium and the detection of a pyloric tumour, do not wean the baby, but keep it fed on the mother's milk at all costs.

If the baby has been weaned, then every effort should be made to restore the mother's milk. If this is impossible, then the milk of a wet nurse should be procured. Failing this, goat's milk is the next best substitute.

The best temporary food, if none of the above can be obtained, is sherry wine whey sweetened with glucose, and with this I have given subcutaneous injections of sea-water plasma (50 c.cm.) every third day, and small doses of belladonna. After two days' feeding with sherry whey and glucose, very weak citrated Benger's food may be added to the diet, and generally agrees well with these patients. After the first week citrated cow's milk well diluted with barley water, and a small quantity of virol stirred into every second feed is the diet of choice, and a teaspoonful of raw meat juice every day is recommended. Dried milk and condensed milk are not advised, as the irritable intestinal tract of these babies will not tolerate them, and they are passed undigested.

These babies are best nursed in a side ward away from the general ward, and the greatest care should be devoted to the sterilization of the feeding-bottles.

If weak Benger's food and citrated cow's milk are

badly tolerated, then we must again resort to sherry whey and glucose, but more gradually introducing the other foods, and in the meantime slightly increase the dose of belladonna.

The greatest patience, perseverance, and care must be exercised in the artificial feeding of post-operative cases, and the above-mentioned routine has given uniformly the best results in my series of cases.

There is no doubt something in the mother's milk, probably in the nature of a vitamin, that is so essential for the welfare of these babies after the pylorospasm has been relieved. This vitamin, if such it be, exercises a controlling effect on the gastro-intestinal irritability, and overcomes the main difficulty in the post-operative treatment—a difficulty, indeed, that has taxed the resources of both physician and surgeon to their utmost.

SUMMARY OF CASES.

Rammstedt's operation.—Of 45 consecutive cases, 42 were males and 3 were females, i.e. 93 per cent. males; 43 occurred from the tenth to the seventeenth day after birth; two culminated at the tenth week. The two cases culminating at the tenth week were both females, and both recovered. Neither was breast-fed, and neither showed the degree of gastro-intestinal irritability exhibited in the male cases.

Thirty-two cases recovered (including the three females) and thirteen died, showing a recovery of 70 per cent. Of the 32 recoveries, 21 were breast-fed after operation, four received the mother's milk taken off by a pump, three received the milk of a wet nurse, and four were fed artificially. Of the 13 deaths, all were male babies, and all were fed artificially.

The cases are consecutive, and in no way selected. These figures speak for themselves, and will, I hope, convince the reader of what has been written in the text.

The Respiratory Factor in the Post-Operative Treatment of Tonsils and Adenoids.

By J. DUNLOP LICKLEY, M.D.

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SPEAKING generally, there are two chief types of tonsils and adenoids cases:

(A) *Obstructive Type.* Those in which the symptoms of mechanical obstruction predominate.

(B) *Toxic Type.* Those in which the main symptoms arise from toxic absorption.

The ordinary case combines in varying degrees the obstructive and toxic elements, but it is useful for purposes of discussion to consider the types separately. In both there is a history of special susceptibility to, and frequent attacks of, chest trouble, and it is this fact which has suggested the theory of a selective system involvement.

(A) In the *obstructive* type the causation of the chest disturbance seems fairly obvious. The function of the nose is to rid the inspired air of dust and organisms, to warm it and to add water to it. Air inspired through the mouth is less efficiently treated and on reaching the air-tubes is colder, drier, and more dusty; it tends to set up a spasm of the bronchial muscles and less air is allowed to enter the lungs. When this obstruction is superadded to the already narrowed air-inlet, the chest fails to expand properly, and a chronic bronchial

catarrh supervenes. In some of these children the chest musculature is surprisingly good, since they are compelled to develop their muscles of forced respiration, and this in the absence of toxic poisoning they are able to do. Wills and Warwick[1] have made the interesting observation that in children with simple septic tonsils the muscle-tone is good, but where true hypertrophy of the adenoid tissue of the throat is present muscular flabbiness is the rule.

The common forms of chest deformity associated with the obstructive type are the pigeon breast and the chest, with a marked depression (longitudinal and transverse) at the lower end of the sternum. In some cases the movement effected by the vertebral part of the diaphragm is almost sufficient to keep up, without respiratory distress, the tidal flow of air. When any call is made for additional air, the mechanism responds by trying to increase the downward thrust of the diaphragm; the lower ribs are fixed by the lateral abdominal muscles, and the costal part of the diaphragm assists in the movement. If there is any tendency to softening of the ribs the transverse diameter of the thorax is actually diminished and the result is the pigeon breast. In other obstructive cases an attempt is made to increase the lifting power of the costal part of the diaphragm; this is done by pulling in the anterior abdominal wall, thus increasing the steepness of the diaphragmatic dome and steadying the central tendon. The effort is again a partial failure since it is mechanically impossible to draw in through the obstructed channels a normal amount of air; the effect, however, is seen in the depression of the lower end of the sternum, and the broadening of the transverse diameter of the lower part of the thorax. A cyrtometer tracing of the lower part of the chest is almost kidney-shaped.

Cases of the obstructive type usually do very well

after operation. The removal of the obstruction, with the consequent enlargement of the air-inlet, permits the muscles to resume their normal balance, and since the muscle-tone is generally good, recovery is rapid. The main indication in the after-treatment is to teach the children to breathe through their noses. Nose-breathing exercises, such as those suggested by Handcock and advocated by Hickling[2] are useful; their value is enhanced, however, if they are followed by the special respiratory exercises considered later.

(B) It is in the *toxic* type that the most striking respiratory alterations are demonstrable, so much so that they lead to a stance of the child which is almost diagnostic. These children apparently breathe fairly easily through the nose with the mouth shut, but when they are stripped their defects are very evident. The upper part of the chest in front is narrow and flattened and looks sunken, an appearance which is contributed to by the position of the shoulders, which are drooping and rolled forwards so that the scapulæ stick out behind; a slight kyphosis may be present. The abdomen is prominent and somewhat pendulous, and this is associated with some degree of lordosis. Except in cases where rickets coexists there is no deformity of the bones of the thorax.

Cameron[3] has described an extreme form of this condition in discussing "Dyspepsia and Malassimilation in Children." His reference relates particularly to "a form of dyspepsia in older children consequent upon nutritional defect," and the special interest attaches to his statement that "the whole deterioration of health, in very many cases, is due to some focus of chronic infection, such as imbedded tonsils which are septic."

Under the title "The Hypotonic (Flabby) Child," Paterson,[4] in a recent paper, has included this type. He investigated (for his whole group) the causation in

relation to (*a*) diet, chiefly carbohydrate excess; (*b*) confinement and lack of exercise; (*c*) toxic absorption; and (*d*) constitutional defect; and found that no one of these factors was sufficient to cause the condition.

The suggestion here advanced is that the additional factor required (at least in the tonsils and adenoids cases) is the peculiar involvement of the whole respiratory apparatus; the original toxic element is derived from the infected lymphoid tissue of the throat; later, toxic effects may follow from the faulty respiration.

The respiratory inefficiency is probably due in part to the general muscular weakness, although other causes of general debility do not lead to such a marked degree of inefficiency. One may notice also that in some cases (presumably early cases) the limb muscles are fairly good and yet the trunk is quite characteristic. The condition is mainly the result of the almost specific flabbiness of the two great respiratory antagonists—the diaphragm and the abdominal muscles. The laxity of the abdominal wall permits a general dropping of the abdominal viscera, and this is accompanied by a fall in the height of the diaphragmatic dome. The mediastinum is pulled downwards and backwards, and the downward slope of the ribs becomes more pronounced. The flattening of the dome impairs the mechanical efficiency of both parts of the diaphragm by lessening the distance through which the central tendon can be pulled down and the distance through which the circumference can be lifted up. When this mechanical disability is combined with a lowered tone of the muscles, respiration becomes very inefficient. The defective ventilation is particularly liable to affect the apices, posterior borders and hila, which may therefore become favourable breeding grounds for bacterial infections.

It will be evident that in these cases the operation for the removal of the original toxic source should be supplemented by post-operative treatment of the

muscular disability. In some instances very marked benefit results from merely keeping these children in bed for a few days; by thus relieving the strain on the abdominal wall the respiratory muscles are able to recover some of their tone. Any of the recognized courses of physical exercises or drill is beneficial. Galbraith[5] has insisted on the importance of massage and exercises in treating flabby children, and in most of the text-books it is mentioned that respiratory exercises (not usually described) are useful after tonsils and adenoids operations.

The point I wish to insist on is that the very definite (almost specific) implication of the respiratory musculature has not been fully recognized. When its clinical importance is appreciated then it follows that, combined with the general hygiene of the respiratory tract and with the general exercises, there should be special exercises designed to restore as soon as possible the normal position and action of the respiratory apparatus. Nose-breathing exercises, such as those of Hickling, provide an interesting commentary, since their devisers noted the great general improvement in the children in spite of the fact that the lymphoid growths were not much diminished; the effect of these exercises on the general respiratory mechanism contributed very largely to their good results.

In many of the cases it is wise to begin by instructing the children how to blow their noses. The scheme of the special exercises is as follows:—

(1) Exercise the vertebral part of the diaphragm and with this combine some exercises for strengthening the abdominal muscles; these are done at first with the child in the supine position.

(2) Practise these in the erect posture and then proceed to exercise the costal part of the diaphragm.

(3) Correct the general stance.

It is almost unnecessary to add that during all these

exercises breathing should be carried on through the nose, using at times both nostrils and at other times each nostril alternately. There is no need for a prolonged course of the exercises, except in a few difficult cases; most of the children readily learn what is required of them, and once the faults are corrected the normal rhythm is soon established. Regularity in their performance and intelligent appreciation of the exercises are all important.

It may be thought that the respiratory element is merely one of the minor factors in the vicious circle resulting from the lymphoid infection. When one remembers the direct but far-reaching effects of respiration on the circulatory system and on the abdominal viscera, one must realize its great importance; clinical observations and the results of post-operative treatment confirm the impression that it is an outstanding factor in tonsils and adenoids cases. If one would diminish the risk of recurrence of the adenoid growths, and lessen the chances of chronic nasal and bronchial catarrhs, which one meets with so frequently in adults with faulty respiration, the aim in treatment of tonsils and adenoids cases should not be merely to secure, by operation, efficiently treated air, but to ensure by after-treatment that the air is efficiently distributed to all the pulmonary alveoli.

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The Endocrine Basis of Pernicious Vomiting in Pregnancy.

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SOME years ago Ellis, of Montreal, propounded a plausible theory to account for the production of pernicious vomiting in pregnancy, on the assumption that it was a toxæmia. Both before and since, this has been maintained by various observers. In the light of our present knowledge of the rôle played by endocrines in the various animal functions carried on throughout life and, in particular, the effects of these endocrine substances in so far as they are concerned in the very reproduction of the species itself, it occurred to the writer long since that they formed the fundamental basis for the bringing into being of the vomiting of pregnancy, pernicious or otherwise (and the pernicious is only a question of degree), and that any other concomitant conditions, toxæmias, and indefinite states, are merely subsidiary factors. The report of a case by Dr. Stanley E. Denyer[1] leads one to attempt an explanation of the *modus operandi* in the production of the condition under consideration.

One does not quarrel with the statement of Duncan and Harding that glycogen in pernicious vomiting of pregnancy is deficient in amount in the maternal liver, but one does take issue with the statement that it is the basic cause of that syndrome. Why should there be a deficiency of glycogen? The answer to that question will give us much more light on this unhappy

state. It is a fact that fœtal tissues are relatively so much more in possession of glycogen than is the case in adults, that it is strongly suspected that the fœtus is, to a certain extent, responsible for the deficiency of glycogen in the maternal tissues. Glycogen is present in fresh skeletal muscle to the extent of one per cent.; glucose is present to the extent of 0·01 per cent. Glycogen is the precursor of glucose. After a meal rich in carbohydrates, glycogen may be present in the liver up to about 12 per cent. of the weight of the gland. On the other hand, in fœtal muscle it may amount to as much as 40 per cent. of the total weight of the dried solids. This is a disparity far too great to be overlooked; in other words, it is forty times as much in the fœtus as in the skeletal muscle, and nearly four times as much as in the maternal liver. This needs some explanation.

During pregnancy the function of the endocrines must necessarily undergo some modification. It can readily be shown that the injection of the secretion of the posterior lobe of the pituitary body will produce hyperacidity and a marked increase in gastric secretion and peristalsis, not to mention its effect upon the intestine, uterus, urinary bladder, etc. The pituitary gland bears a large responsibility for the digestion of food through its gastro-enteric activity, and in nearly all cases of carbohydrate intolerance the pituitary gland is involved.

During starvation glycogen is rapidly used up from its storehouse in the liver; exposure to cold has the same effect, and during muscular exercise glycogen is also used up. During pregnancy the interstitial secretion of the ovary is under the control of the corpus luteum, which Professor W. E. Dixon has shown has practically no influence in stimulating the pituitary gland to activity. If the power of the pituitary to contract the uterus were as great during pregnancy as

at other times, or were this power not otherwise controlled, intrauterine gestation would be impossible, as the uterus would be automatically emptied. It is probable that there is a hormone which, by inhibition or otherwise, prevents what pituitrin there may be in the blood-stream from exerting its full contracting effect on the uterine musculature. This hormone is probably that of the mammary body, corpus luteum or placenta, acting singly or in concert to offset the enhanced activity of the pituitary body consequent on the ovarian secretion, which is in excess during the congestion of pregnancy. As demonstrated by Professor W. E. Dixon, the ovarian hormone is the only substance which invariably stimulates the pituitary body to increased activity.

Adrenalin acts mainly on plain muscle supplied by sympathetic fibres, and gives contraction or relaxation as the nerve fibres are motor or inhibitory. Posterior pituitary secretion acts directly on the muscle in all cases. Both these hormones influence the general metabolism, and particularly accelerate the glycogenolysis in the liver.

Removal of the posterior lobe of the pituitary gland in animals results in a greater carbohydrate tolerance; much more carbohydrate food can be taken without producing alimentary glycosuria. During pregnancy there is a marked increase in the size of both suprarenal cortex and pituitary bodies. Competent observers have insisted on the fact that the suprarenal cortex has some relation to the activity of the sexual glands. The increase in the cortex of the suprarenal in pregnancy is a hypertrophy. The operation of castration causes marked changes in the adrenal cortex. The various phenomena of sexual life are associated with histological changes in the adrenals.

Some observers are of opinion that the internal secretion of the pancreas stabilizes the output of

glycogen from the liver. If this internal secretion be deficient or inhibited the output of sugar is above normal. Instead of intensifying the fall produced by insulin a simultaneous injection of pituitary extract either reduces, abolishes, or replaces by a rise of blood-sugar the fall due to insulin.[2] This shows *inter alia* that there is a relation between the pancreas and the posterior pituitary body.

Carlson and Drennan [3] have produced an extraordinary bit of information. They have shown that if the pancreas be removed from a pregnant dog near term, it is not followed by glycosuria until the pups are born or removed by operation. While not flatly refuting the contention that this is due to the presence of pancreatic tissue in the pups, which carries on the pancreatic function for the mother as well as for themselves, it has not been shown that this may not be due to other complementary factors acting in addition to this. In the absence of the maternal pancreas before the islands of Langerhans begin to function in the fœtus, mother and fœtus present hyperglycæmia. After development of the islands the mother presents hyperglycæmia, while the fœtus is protected.[4] It has been demonstrated experimentally that the placenta is impervious to the transit of adrenalin.[5] A marked increase in the maternal adrenalin content of the blood is not followed by any increase in the adrenalin content of the fœtal blood. What proof can be adduced to show that pancreatic hormones can and do perfuse the placenta where adrenalin and thyroid do not? This point should be cleared up by the experimenters, for the researches of Tanberg show that thyroid secretion does not reach the mother from the fœtus, the placenta being impermeable to it.[6]

If it can be shown that the placenta refuses transit to the pancreatic hormone and all other hormones, in addition to adrenalin and thyroid, then we are face to

face with the fact that even with the complete removal of the pancreas, as in Carlson's experiment, there are other substances which, under certain conditions—as, for example, pregnancy—for a time at least, are able to act as a substitute for pancreatic function. This will very materially alter our conceptions of carbohydrate metabolism, and change our opinions regarding the production of hyperglycæmia, certainly in so far as the pregnant animal is concerned.

A word or two to show the mechanism by which adrenalin acts may be helpful at this point. Bradycardia, following the administration of adrenalin, is due to an action of the adrenalin on the cardio-inhibitory centre. It disappears when the vagi are resected or paralysed with atropine, and a stronger and more rapid cardio-activity results. In connection with the assumption that adrenalin acts principally on the endings of the sympathetic autonomic fibres, the result infers that the plain muscle involved is supplied with inhibitory fibres. The effect of adrenalin on the uterus varies with the condition of that organ. In the pregnant cat adrenalin produces contraction of the uterus. In the non-pregnant cat it shows relaxation. In other words, some factor is present in the pregnant cat which inhibits the action of the inhibitory fibres and which is absent in the non-pregnant cat.[7] D. Cow shows that pituitrin activates the uterus to an increased response to adrenalin. Now, the uterus and the vagina receive no vaso-motor fibres from the nervi erigentes, but do receive a supply of constrictor fibres from the sympathetic system. These latter fibres emerge from the cord in the roots of the upper lumbar nerves, and are distributed by the inferior mesenteric ganglion and hypogastric nerves.

The importance of some aspects of pituitary and adrenal activity is very great. If they are both capable of producing effects in addition to those acting on the

lines just indicated in the usual state of things, during the state of pregnancy their action may be greatly enlarged, as, to wit, the producing increased glycogenolysis, hyperglycæmia, and glycosuria. Pituitary secretion particularly produces hyperglycæmia and glycogenolysis, but more of the latter, though both adrenalin and pituitary, under certain conditions, produce glycosuria.

If Cow's statement that pituitrin sensitizes the uterus to an increased response to adrenalin be true, there is the probability that this function may be extended to the pancreas in such a condition as pregnancy. In this case the result would be that the inhibition of the pancreatic function, say by adrenalin, would result in a deficiency or alteration of the internal secretion of the pancreas, which would result in the depletion of the glycogen content in the maternal liver. It is known that the ill-effects of insulin injections which occasionally arise may be improved by the injection of adrenalin. Possibly adrenalin inhibits the action of the pancreatic hormone. A report by F. Rathery and F. Bordet[8] presents a case of vomiting (persistent) in pregnancy of two months, during which the patient suffered from inanition, dehydration, accompanied by acidosis:

> After two or three days of treatment by injections of adrenalin in large amounts of normal saline, the symptoms ceased, and did not reappear when the drug was withdrawn. The rapidity of the action of the drug is to be noted. The doses used were: first day, 0·5 mgm. subcutaneously; second day, 1 mgm. subcutaneously, and 1 mgm. ingested; third day, same dose; fourth day and following seven days, 1 mgm. ingested. The increase in weight was very rapid, and at the rate of one kilo per day for nine days. It did not cause glycosuria.

In the opinion of the writer of this present article the failure of glycosuria to appear may be explained as follows: because of the glycogenolysis in excess, the maternal tissues were starved of glycogen and glucose, and retained all the liberated sugar, not excreting

them. Probably glycosuria would have resulted had the adrenalin treatment been persisted in for a longer period. Incidentally, Hugounenq and Ensleme have noted a ferment in the blood which hydrolyses insulin. It is probable that the absence of a sufficient amount of glycogen in the maternal liver, in the vomiting of pregnancy, is due to a great increase in the function of the pancreatic hormone, causing sugar consumption—just the opposite of diabetes mellitus. It is possible that this is due to a deficient or altered hormone (or it may be due to cortical hormone) which in normal individuals inhibits the pancreatic hormone when the proper amount of blood-sugar is present. In other words, adrenalin may act as a safety valve for blood-sugar stability, that metaphorical valve opening or closing automatically with the rise or fall above or below normal in the blood-sugar content. This adrenalin deficiency may be produced by the markedly enlarged suprarenal cortex, which has been shown exists in pregnancy, pressing on the medulla of the suprarenal body, so cutting off its blood supply by ischæmia, thereby permitting the posterior pituitary hormone to run riot in glycogenolysis. The complete extirpation of the adrenals results in the total disappearance of blood-sugar. The pituitary hormone is then triumphant.

It has been stated elsewhere in this article that the pituitary gland is largely involved in the production of carbohydrate intolerance. If there be a deficiency in adrenalin output in the hyperemesis of pregnancy, obviously there is an interruption in the physiological inter-relation of pituitary and adrenal secretions, which Cow has shown exists. The placenta does not allow of the passage of adrenalin from the fœtus, and the pituitary gland secretion has full play in the production of a carbohydrate intolerance, and a consequent lowering of the glycogen content of the maternal liver,

the glycogenolysis having run to exhaustion, and the fœtus taking all it can get.

Corpus luteum and mammary hormones are the antagonists of the ovarian and pituitary hormones, the latter perhaps indirectly. The exhibition of them in the vomiting of pregnancy produces the desired result, as might be expected.

The great increase in uterine blood supply favours the production of more of the secretion of the ovarian interstitial cells. The increase in ovarian interstitial secretion stimulates the pituitary secretion, while the corpus luteal, placental, and mammary hormones counteract the effect of this increased quantity of pituitary hormone on the uterus. If there should be a deficiency in corpus luteal or mammary hormone the pituitary secretion gets out of control, and we have the hyperemesis of pregnancy. If this were so one would expect the exhibition of mammary or corpus luteal hormones to give relief—this is precisely what happens in actual practice in cases of hyperemesis—they do give relief at once and in a startling way.

We do not need to go outside the endocrine system in order to explain the cause of the maternal glycogen deficiency. Adrenalin is probably manufactured as a by-product of tyrosin, as is suggested by the presence of the oxyphenyl group in the chemical composition of the hormone. Tyrosin is a by-product of protein katabolism. If there be not sufficient ingestion of protein to allow of tyrosin and amino-acid derivatives being produced, the suprarenal bodies have not the materials from which to make adrenalin, except from their "tissue protein." Once allow the vomiting of pregnancy to get well under way and at once a vicious circle is established, which circle must be broken if life is to be conserved.

On the assumption that during pregnancy the pituitrin constituent in the maternal blood is pre-

cluded from having its full effect in the pelvis, it finds a natural and necessary outlet for its activity in the gastro-enteric organs. It is essential that the increase in gastric juice brought about in this way, by pituitary effort, should be used up. The increase in juice is obviously natural—there are two to feed. If the gastric juice be not "fixed" by protein foods there will follow automatically sickness and vomiting, from the effect upon the gastric mucosa of this stagnant juice. There is, therefore, brought about a gastric acidosis which, with its symptoms, prevents the ingestion of food, and a train of symptoms not unlike those of acid dyspepsia follows, which, in fact, is really the case in the pernicious vomiting of pregnancy, excepting that the picture in the latter is extreme. The maternal tissues are in a state of deficiency of glycogen, similar to that produced by starvation. All this while the fœtal tissues must have glycogen, and they take it whence they can get it.

To conclude, the rational treatment of pernicious vomiting in pregnancy will follow the lines in opposition to the cause. In some minds corpus luteum, the opponent of ovarian and indirectly, therefore, of pituitary activity, is a definite specific for the pernicious vomiting of pregnancy. Its exhibition in sufficient doses has disadvantages. Based upon a considerable clinical experience the writer has found that mammary substance, by mouth, or the extracts (10 per cent.) hypodermically, even in large doses, is not deleterious, but produces startlingly good results, because of its antagonism to the ovarian function, which in the early stages has not reached a balance under the new conditions. If, in spite of vomiting, a largely enhanced protein diet be insisted upon, to the complete exclusion of all stimulants to gastric secretion, which do not "fix" gastric juice, such as meat extracts, dextrinized foods in general, condiments and

alcohol, the condition automatically rights itself, if it has not been allowed to advance too far. If the latter condition exists, adrenalin injections will control the vomiting, so allowing the protein diet to be commenced.

The simple expedient of taking a glass of milk fifteen minutes before quitting the recumbent position in the early morning, by women in the gravid state, is often sufficient to ward off any vomiting, and may prevent the supersensitiveness of the stomach associated with pregnancy from the sixth to the fourteenth week or, in fact, during any phase of pregnancy. Should the protein diet appear inadequate at the commencement it will be found to be due to the lack of perseverance with an all-protein diet, and to the non-interdiction of liquids at meal times. Allow no fluids at meal times. It goes without saying that definite disease in the stomach or elsewhere, such as gastric ulcer, etc., might lead to disappointment, and these conditions should be excluded before commencing this treatment.

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Light and its Therapeutics.

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NEW uses for light-therapy are being found every day. The field of its application is being widened and broadened, until one is amazed at the possibilities before it, and the day of its adoption by the profession in general is not in the dim and distant future, but is now the appointed time. The curtain is even at this present time going up on the prospect of the possibilities of actinotherapy. These are wellnigh boundless, and one has but to peer into their potentialities to realize enthusiasm rising within one, and to feel oneself carried forward with the workers in it.

I propose to limit myself to artificial light and to present only a short introduction. Opportunities for learning about it up to very recently have been few, in fact, only in October, 1924, was the first book published in England on the subject.[1] Actinotherapy itself is, of course, of very considerable antiquity. Treatment by light has existed from the earliest era of which any record exists. "Light is the Life of Man" was written many centuries ago, and has long been recognized as being of paramount necessity to the well-being and very existence of the human race. It is a matter of common knowledge that the ancient Egyptians, the Greeks, and the Romans were all firm believers in the health-giving efficacy of sunlight. Their physicians prescribed it as a matter of course, both

for the cure and the prevention of the various diseases and ills which afflicted humanity in those days. Herodotus has left it on record that light was to be regarded, by the physician who knew his business, as a preface to the prevention of illness, and Cicero tells us of *solaria*, or light-rooms, that were established in the villas of Rome's leading citizens.

Many institutions in many countries have established light for the treatment of sickness, etc., but we have recently introduced artificial sunlight among adults as a purely preventive method. It is no small matter to keep people well, rather than to make them well, not only to keep them fit, but to make them fitter than they are, to maintain or create that feeling of well-being which should be ever present in each human body, to enable it to feel the joy of work, the joy, indeed, of just being alive.

From a practical point of view this may be accomplished quite apart from the treatment of disease, by artificial sunlight—and what is artificial sunlight? Artificial sunlight is light produced by means of electricity. It does not consist of the whole of the sun's rays, but it does include such of them as have been found to be most beneficial to health. These rays are actually absorbed by the blood, which carries health to every part of the body. It is held by some authorities that the exhibition of these rays is even more beneficial to the body than those of the sun itself, inasmuch as they can be administered with greater accuracy and contain a greater intensity of the beneficial rays, with an absence of any harmful rays. Whether this be so or no, I am afraid that if we could stay, say, at a mountain resort in a sunny, dry atmosphere, above the pall of smoke and dirt with which this city of ours is usually covered, we should choose it in preference to any form of artificial light. But it is because we cannot fly off to

Switzerland, Biarritz, or the Lido for a sun-bath twice a week that we gratefully turn to its convenient scientific substitute.

It is somewhat difficult to explain (partly, perhaps, owing to the deficient state of our present knowledge) the manner in which artificial sunlight produces its good effect. We know that the rays are absorbed by the blood, and that the vital processes are profoundly and beneficially affected by them. Some of the changes produced are due to alteration in the chemistry of the blood, such as the increase of the calcium, phosphorus, and iron content of the blood. Others to an increased activity of the vitamins, and others, again, to the stimulation of the endocrine glands.

Perhaps it is not out of place here to discuss briefly what are the effects of the light, and in what way are its benefits achieved. One of the best-known results is the production of erythema. Its production happens thus: the light excites the nerve endings in the skin, this taking place owing to the power of the light to create fluorescence in certain substances in the skin. This can easily be shown. If the source of the ultra-violet radiation be surrounded by dark-tinted quartz, which will not allow the luminous rays to pass, the skin will be seen to fluoresce. This is due to the presence of hæmatoporphyrin, and possibly other substances. This fluorescence produces an irritation of the sensory nerves, which (by means of an axon reflex) dilates the blood-vessels in the skin and subcutaneous tissues.

Another familiar local effect produced by light is pigmentation, and this may be a reaction in some way related to endocrine balance.

Coming to the general or systemic changes there are, as Professor W. E. Dixon, of Cambridge, summarized recently,[2] mild stimulation of medullary centres, slight increase of the pulse-rate, and stimulation of respiration. There is an increased activity of the tissues, as shown by

an augmented power of phagocytosis of the leucocytes, and, as mentioned by Leonard Hill,[3] the hæmo-bactericidal power of the blood is enhanced by exposure to ultra-violet radiation. Lastly, we have the specific action of light, and that is its power to increase the calcium and phosphorus content of the blood and to confer upon it and upon certain foodstuffs anti-rachitic powers. I need not dilate upon the enormous importance of this. It has been explained that this is due to the influence of light upon cholesterol. This substance undergoes certain changes when exposed to light. The skin contains a large amount of this cholesterol. It is also present in wheat, flour, milk, eggs, lard, oil, etc., and these articles of food, when exposed to ultra-violet radiation, develop anti-rachitic properties, even as the rachitic patient, when his skin is irradiated, is cured of his rickets.

Of other benefits to be derived from treatment by artificial light it is necessary to say a few words, though it is difficult to do this without hyper-enthusiasm, with the remembrance so vividly in one's mind of patients who have benefited from this form of treatment. A question very frequently asked is: For what class of patient is it useful? Apart from those who suffer from anæmia, or painful and other illnesses, there are many who hardly come into the category of patients at all, but to whom one would certainly recommend a "change of air." While I have no wish to decry this venerable and valuable prescription, it is obvious that the carrying out of it is not always within the range of practical politics. But who is there who would not benefit from a visit of three or four weeks at the seaside? And all such will benefit from heliotherapeutic treatment. Again, there are those cases in both young and old who are never really ill, but yet never really well—delicate, easily tired, perhaps irritable children or adults, where the most careful examination fails to find actual disease.

The effect of light upon the general condition of these people is most remarkable. The irritability and fractiousness go; the appetite returns, and the body weight and strength become normal. They no longer catch colds easily or complain of things in general or of themselves in particular. In fact, they feel every day, in every way, brighter and better.

Of the rejuvenating properties of light, artificial or natural, in later life, mention must also be made. From the time, thousands of years ago, when it was stated in the sacred writings of the Hindus that sunlight was able to restore vigour to the muscles and brighten the intellect of the elderly, down to the present-day literature, such as Lorand's book,[4] there is plenty of evidence of this property of the rays. They undoubtedly have a definite influence for good upon muscular agility and mental activity. Soon after commencing treatment patients usually note a disappearance of lassitude and fatigue, and become conscious of a feeling of well-being and of a capacity to enjoy life, which, before receiving the benefits of light, they had almost forgotten.

Ultra-violet radiation has undoubtedly been used more frequently in dermatological conditions than in any other class of disease. Among these, pride of place must be given to lupus, the treatment of which was begun by Finsen (the creator of artificial light treatment) in Copenhagen, and in this country by Sequeira. Probably more cases of lupus than all other skin diseases together have been treated by ultra-violet radiation, yet there is a great variety of the latter in which these rays can be profitably employed, and the reason of this may be seen in a sentence of an old teacher of mine, Radcliffe Crocker,[5] in which he states that the key-note of modern dermotherapeutics is antisepticism. Now, as ultra-violet radiation is a powerful antiseptic, when the affected skin is bathed

in it, one reason for its efficacy in a great variety of skin diseases is made plain.

I do not propose to enumerate the long list of dermatological or other conditions in which artificial light is used or is usable, but simply those in which I have had the greatest success. These include furunculosis, eczema, alopecia, especially alopecia areata, onychia, chilblains, Raynaud's disease, psoriasis, and pruritis; in all of these I have had most gratifying results. Apart from the treatment of diseases of the skin, other therapeutic uses, in addition to those already mentioned, are found for this agent in cases of disease in general. In the alimentary system, digestive disorders, gastritis with acidity, and even gastric and duodenal ulcers have benefited by it.

In gynæcology artificial light is capable of yielding very good results. In disordered menstruation I have found it of great use, especially so in those patients who are undergoing X-ray treatment for the production of an artificial menopause. Here, I think, it acts in two ways. Firstly, its effects tend to brighten the outlook of the patient on life in general, and create a feeling of cheerfulness and well-being, which is usually absent at the climacteric, whether natural or artificial. And secondly, by raising the calcium content the coagulability of the blood is increased, thus aiding in avoiding profuse hæmorrhages.

In regard to the nervous system, those troublesome cases of neurasthenia, almost border-line cases, will improve very much with heliotherapy. In certain cases of nervous diseases, especially insanity, it has been shown that the phosphate ratio is lowered. When it is remembered that the exposure of the whole body to ultra-violet radiation raises the phosphorus content, it would appear that there are even further uses for it in the nervous system.

Artificial light has the power to relieve pain in sciatica

and lumbago, and other forms of fibrositis and neuritis; in fact, the immediate effects of its analgæsic properties sometimes appear little short of miraculous.

I fear this may seem an astonishingly long list of diseases. I am not claiming, however, either now or on the crest of my most optimistic wave, that artificial light will cure all, or indeed any of them, but I do say that at some time during the past fifteen or twenty years each of these conditions has been treated by this agent in most cases with benefit, and in many with success. Furthermore, we have in heliotherapy a remedy incapable of inflicting injury when used with ordinary skill and care, and a remedy, moreover, having a rational basis from which a fabric of therapeutic good may be expected to arise, and having arisen, to stand firm. One point more, and perhaps the most important, is the value of the rays in keeping one fit and well. The doctor who prevents is greater than the doctor who cures. Inasmuch as artificial light will restore vigour to the muscles and brighten the intellect when these show signs of failing, so, if taken in time, it will delay or prevent that failing.

Artificial sunlight is the ideal treatment of health, which is, perhaps, equally important as the treatment of disease, though it does not receive the attention it deserves. Prevention is better than cure, and artificial sunlight will ward off many a breakdown, and prove more effectual than the proverbial "apple a day."

References.

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On Counter-Irritation.

By EDGAR F. CYRIAX, M.D.
London, W.

THE term "counter-irritation" was introduced about a hundred years ago, and soon superseded the older ones of "revulsion" and "derivation." For the convenience of description the applied therapeutics of a counter-irritant may be summarized under four headings: (*a*) Application to the skin; (*b*) obvious stimulation thereof; (*c*) reflex impulses from the irritated cutaneous nerves to deep-seated areas (visceral or otherwise); and (*d*) resultant vascular changes in the latter. Now, if these definitions were to be rigidly adhered to, a large number of other agents which act very similarly would have to be excluded, for example:

1. Those which conform to (*a*), (*b*), and (*c*), but which do not primarily produce vascular changes in deep-seated areas, such as the following:

(A) Rubefacients which, when applied to the lower dorsal area, induce irritation of the posterior roots, the anterior roots, the rami communicantes, and the sympathetic nerves, finally inducing through the splanchnic nerves a condition of inhibition of the intestines.

(B) Rubefacients which, when applied to the neck, influence the inhibitory fibres of the vagus nerve. Amongst these may be mentioned the application of cantharides to the neck as performed by Brand[1] and Johnson,[2] who employed it with success in asthma, exophthalmic goitre, whooping cough, and sea-sickness. Mays[3] stated that in cardiac irregularities he had found massage and cutaneous irritation over the vagus nerve to be of considerable benefit.

2. Those which produce exactly the same effects as counter-irritants applied, but do so through the deep-

seated nerves from which spring the cutaneous ones affected by such counter-irritant; for instance:

(A) "Nerve frictions" applied according to the methods of the late Henrik Kellgren. By this manipulation is meant the mechanical stimulation of a nerve induced by drawing one or more digits sharply across it. When such nerve frictions are applied to the deep-seated posterior spinal nerves as they lie embedded in the erector spinæ, many visceral changes may be thereby induced, such as constriction in the splanchnic area (as evinced by the rapidity with which a subject who has fainted can be revived by nerve frictions applied to the lower dorsal area), diminution in the size of the liver from vaso-constriction of its vessels (as evinced by diminution of its percussion dullness after nerve frictions applied to the fifth to seventh dorsal nerves on the right side), etc.

(B) Tapotement applied to localized areas near the spine, which has been employed by the Swedes for nearly a hundred years for a variety of complaints in the thorax and abdomen, induces its effect in very much the same way as nerve frictions.

(C) Tapotement applied with the closed fist or a special pleximeter over the actual spinous processes instead of at the side of the spine. This method, known as reflexotherapy or spondylotherapy, has been used by several workers in order to induce reflex vascular effects in the abdomen.

3. Those which conform to (*a*) and (*d*), but do so without any irritation of either the cutaneous or deep-seated nerves, even in some cases diminishing it if already present, as, for example:

Vibrations according to the methods of the late Henrik Kellgren. The method of executing these by means of the minimum amount of alternating contraction and relaxation of some of the muscles of the fore-arm, the muscles of the upper arm not participating,

has been described by me on several occasions (see "Collected Papers," 1924). When applied to localized areas at the side of the spine they can by reducing the irritability of the nerves in that area induce reflex vascular effects in the corresponding abdominal organs.

4. Those which conform to (*a*) and (*c*), only primarily induce motor effects, any visceral ones being secondary; these are often referred to as counter-irritants. Thus, gentle stroking with a trembling motion on the left costal margin, which induces gastric peristalsis in atony of the stomach,[4] is often designated as such, as is also the application of nerve frictions to the posterior sacral nerves in inducing contraction of the rectum. I have even heard the term applied to very gentle soothing vibrations applied over the temple in severe supraorbital neuralgia.

Many other examples could be cited, but I think the above suffice to illustrate what I have endeavoured to show, namely, that to apply the term counter-irritant to all those mentioned above is often incorrect, either as regards the "irritant" action or the dictum that the effects are primarily vascular, or that they are always induced through cutaneous nerves. In addition, there is doubtless in many cases a direct effect in addition to, or even replacing, the reflex one.

I therefore suggest the abolition of the term "counter-irritant," and its replacement by others that convey a better idea of the *modus operandi* such as "counter-sedative," "counter-inhibitant," or "counter-analgæsic." In certain cases it might be of advantage to use even longer terms, such as "counter-gastro-peristaltic" or "counter-splanchno-dilator." The exact choice I leave to the profession.

References.

[1] *Lancet*, 1912, i, p. 1756. [2] *Brit. Med. Journ.*, 1912, ii, p. 1588. [3] *Amer. Prac.*, 1912, lvi, pp. 578–582. [4] Mitchell, *Lancet*, 1911, i, p. 226.

Practical Notes.

The Chemical Diagnosis of Cancer.

H. J. Fuchs reports the result of his experimental work on the chemical diagnosis of cancer. He made examinations in ninety-two patients suffering from cancer, and in forty-eight control cases. In each of the cancer cases, he states, the serum from the patient digested heated human fibrin, while in the control cases the result was negative in every case. The method awaits corroboration by other workers.—(*Klinische Wochenschrift*, December 3, 1925, p. 2350.)

Treatment of Cancer of the Breast by Radium and X-Rays.

J. H. Douglas Webster, J. P. Thievens, and F. G. Nicholas report the results of the treatment of fifteen cases of operable carcinoma of the breast by radium and X-rays. The authors do not suggest that radiation should be preferred to operation in operable cases of breast cancer, but they consider that radiologists ought to study and discuss the problems of the treatment of operable breast cancer, as radiation should give good results in operable cases. Of their fifteen cases, there have been two deaths (one due to an intercurrent disease, and one to the disease over two years after treatment had been discontinued); three are new cases, but in one of these there is now no sign of disease; one is having treatment for a radium dermatitis, the disease appearing arrested; and the remaining eight have been for some time in good general and local condition.—(*British Journal of Radiology*, February, 1926, p. 59.)

Treatment of Renal Insufficiency with Bismuth.

A. Yarotzky has treated renal insufficiency with bismuth carbonate, giving up to 50 grams daily. His theory is that, as bismuth carbonate forms an oxychloride, insoluble in water, when it comes in contact with the hydrochloric acid of the stomach, and thus can remove an increased amount of the chlorides from the body, the insufficiency of the kidneys is combated by causing the elimination of sodium chloride and urea by the digestive system. The bismuth carbonate, given in milk, stimulates the secretion of hydrochloric acid in the stomach and so increases the excretion of chlorides from the body.—(*Paris Médical*, December 12, 1925, p. 506.)

Causation of Uterine Fibroma.

J. Dalsace and Guillaumin suggest that certain women may have a special predisposition towards the formation of fibromata. They

base this theory on having examined the blood in a number of patients suffering from uterine fibroma and having found a greatly increased amount of phosphorus in the blood. The quantity of phosphorus dropped very considerably in three cases out of five after ovariectomy, and in four of the cases the amount of calcium in the blood was also reduced after operation.—(*Comptes Rendus de la Société de Biologie*, November 20, 1925, p. 1208.)

Treatment of Laryngeal Cancer by Laryngo-fissure.

Gabriel Tucker states that early diagnosis is essential for cure in cancer of the larynx. In any case of hoarseness a decision as to malignancy should be reached within two or three weeks. Laryngo-fissure for cancer of the larynx in early, anterior, intrinsic growths in which there are no metastases or arytenoid fixation, shows relative cures in about 85 per cent. of cases in those of St. Clair Thomson, and 79 per cent. in those of Chevalier Jackson. Post-operative prophylactic irradiation by the external application of X-rays and radium is useful, but must be used with caution as to dosage.—(*Archives of Otolaryngology*, January, 1926, p. 20.)

Cause and Treatment of Gastric Ulcer.

R. Balint suggests that the chronic nature of gastric ulcers (and also of varicose ulcers of the leg) is due to an abnormally acid reaction of the body tissues, and that alkalization of the whole body, and not only of the contents of the stomach, is necessary to bring about a cure. In animal experiments, he found that the daily injection of an acid mixture retarded the healing of a wound. Of twenty-two patients suffering from gastric ulcer Dr. Balint found that 40 per cent. had an abnormally high hydrogen ion concentration in the blood serum. He explains the action of the Sippy treatment of gastric ulcer with alkalies by its alkalization of the body, as he found improvement result from intravenous injection of an alkaline solution.—(*Wiener Klinische Wochenschrift*, January 1, 1926, p. 7.)

Treatment of Neurosyphilis with Tryparsamide.

P. A. O'Leary and S. W. Becker state that the use of tryparsamide at the Mayo clinic, extending over a period of three years, in 207 cases, leads them to believe that although its use is still in the experimental stage, tryparsamide is of value in the treatment of the paretic type of parenchymatous neurosyphilis. It does not seem to offer as much encouragement as the treatment of general paralysis with malaria, but it is available for those not suited to the risk of the latter treatment. The evidence of the authors, based on subjective and serological improvement, justifies, they assert, the statement that there is a certain small group of patients with early paresis who derive marked benefit from tryparsamide. In seven cases in the whole series there was a complete reversal of the spinal fluid findings to normal, but no associated clinical improvement. They were unable to ascertain the clinical

and serological siteria by which to determine beforehand the patients with paresis who will improve. The objective visual complications offer a hazard (4·3 per cent.) which could not be prevented by special precautions. The use of bismuth intramuscularly in conjunction with tryparsamide seemed to offer better therapeutic results than either given alone. The low cost, availability, and small percentage of complications and reactions are among the advantages of the drug. The continued clinical use of tryparsamide may eventually determine the niche in the armamentarium of neurosyphilitic treatment in which it is to fit with the most encouraging results, but until that time its use is warranted as a valuable adjunct in the treatment of the patient early in the course of general paralysis.—(*Medical Journal and Record* (New York), March 3, 1926, p. 305.)

Prognosis in Exophthalmic Goitre.

J. Marion Read discusses the prognosis in exophthalmic goitre, basing his opinion on the findings in 100 cases of Graves's disease seen by him during the past six years; twenty-five of the patients had been operated on before being seen by Dr. Read; they all still presented some of the signs or symptoms for which thyroidectomy had been performed, and for which they sought further relief. The first fact demonstrated by this group is that thyroidectomy does not always produce a cure, though it usually results in some improvement; the second evident fact is the chronicity of the disease in some patients. Sixteen other patients submitted to surgical intervention, all being thyroidectomized except one, who had double ligation; five of these sixteen died, a mortality rate of 31 per cent. Dr. Read says that his experience with surgery in exophthalmic goitre is such as to dampen any enthusiasm he might otherwise have for this form of treatment. He comes to the conclusion that acute cases of exophthalmic goitre with well-marked onset offer a more favourable prognosis for recovery than those with insidious onset and symptoms existing for several years before seeking medical advice. Males with exophthalmic goitre seem more resistant to treatment and are more apt to become chronic sufferers than females. Subtotal thyroidectomy nearly always produces a remission of the disease if the patient survives the operation, but it does not constitute a cure.—(*American Journal of the Medical Sciences*, February, 1926, p. 227.)

Dangers of Intra-Uterine Application of Radium.

M. Bégonin reports a case where a perforation of the uterus, followed by death, resulted from the intra-uterine application of radium for the treatment of cancer of the body of the uterus. This was the second death in his experience (of 137 cases) within two years, and he warns gynæcologists against the dangers of inserting tubes of radium into the body or the higher part of the cervix of the uterus.—(*Bulletin de la Société d'Obstétrique et de la Gynécologie de Paris*, vol. xv, No. 2, 1926.)

Reviews of Books.

Public Health Laboratory Work (Chemistry). By HENRY R. KENWOOD, C.M.G., M.B., F.R.S., D.P.H., F.C.S. Pp. 369. London: H. K. Lewis & Co., Ltd. 12s. 6d. net.

THIS is really a companion volume to the author's (in conjunction with Dr. Louis Parkes) book on "Hygiene and Public Health," which was favourably reviewed in these pages last year. The present book is restricted to chemistry, the bacteriological work, which had hitherto, in part, been incorporated in the same volume, having grown to such an extent as to require separate and distinct treatment in another volume. This volume consists of 369 pages, five parts, fifteen chapters, and a good index; the student or practitioner can find therein what he wants and all that he wants, in connection with practical public health laboratory work.

Bainbridge and Menzies' Essentials of Physiology. Fifth edition. Edited and Revised by C. LOVATT EVANS, D.Sc., F.R.S., Pp. viii and 508. London: Longmans, Green & Co. 14s. net.

IN this new edition the alterations are mainly those of detail, but considerable additions have been made to keep the matter up-to-date. The book, considering its size, gives a singularly complete review of modern physiological theory, and is just the kind of book for the busy clinician who wishes to keep abreast of the times. Thus we find particulars of the string galvanometer and electrocardiogram, of all the latest work on cerebral localization, accounts of vitamins and other factors influencing metabolism, and of Wrightson's theory of the auditory mechanism. Visual sensations and colour-vision are also dealt with somewhat fully. The vascular mechanism is exceedingly well done, as well as bio-chemistry and bio-physics. The book is copiously illustrated with text figures, some of which are coloured, and all of which are satisfactory.

Favourite Prescriptions, including Dosage Tables and Hints for Treatment of Poisoning. By ESPINE WARD, M.D. Pp. 96. London: J. and A. Churchill. 5s. net.

THIS little book is divided into three parts: the first comprises the posology; the second hints for the treatment of poisoning; and the third prescriptions, which Dr. Ward has found to be of value. These prescriptions are arranged under the headings of the diseases and ailments for which they are recommended. There are upwards of 150 headings and over 400 prescriptions, which provide quite a respectable *armamentarium medicinæ* upon which the practitioner can draw with confidence. As everyone has some favourite prescriptions altogether different from those of other prescribers the book is interleaved to permit of their being inserted. We are sure it will prove of considerable value to medical men whether of small or of extended experience.

THE PRACTITIONER

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Obstructive Jaundice.

By SIR CUTHBERT S. WALLACE, K.C.M.G., C.B., F.R.C.S.

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THE term "Obstructive Jaundice," although in a general sense easily understood, is, perhaps, difficult to define accurately. As a rule the term is used to signify a jaundice which is brought about by obstruction to the outflow of bile produced either by foreign bodies, such as gallstones, within the duct, or by pressure from outside the duct by a tumour, such as carcinoma, or by inflammation of the head of the pancreas. At the same time swelling and inflammation of the mucous membrane, from whatever cause, play a part.

The object of this article in THE PRACTITIONER is not to discuss the means which are taken to arrive at a diagnosis as to whether the jaundice is truly obstructive, but rather to discuss the signs and symptoms and the treatment when the diagnosis has been made.

In the case of gallstones, which is one of the commonest causes of obstructive jaundice, it should be

remembered that obstruction is only present in a relatively small percentage of the cases, and the mechanism by which this obstruction is produced is not altogether clear. In the case of stones in the gall-bladder, it is not uncommon for jaundice to be present, and there is a good deal of doubt as to whether this obstruction is produced by the passage of a small stone into the common duct with its impaction in the narrow portion of the duct and its eventual release in one direction or another, or whether it is due to the swelling of the mucous membrane which would be sufficient, considering the low pressure under which bile is secreted, to produce obstruction. Anyhow, it can be stated that, when the gall-bladder is explored for such a condition and removed, no evidence of any stones or mechanical obstruction in the common duct may be found.

While in the case of stones in the gall-bladder the occurrence of jaundice is rather a matter for comment, in the case of stones in the common duct it is the absence of jaundice which is often remarkable. With comparatively large stones it is easy to see that impaction in the narrow outlet of the duct would be a matter of impossibility, but in the case of small and multiple stones one would expect impaction of a stone at the outlet to be much more frequent than it really is; the removal of such stones from the lower orifice is, luckily, a matter of some rarity.

Again, a patient from whom the gall-bladder has been removed may suffer violent and prolonged attacks of gallstones, and yet show no sign of jaundice. The pain cannot originate in the gall-bladder or cystic duct, for the patient possesses neither. How comes it about that a spasm sufficiently bad and prolonged to require morphia produces no jaundice? The violent contraction of the duct fails to impact a stone in the narrow outlet or, by its contraction on the stones, to

prevent the passage of bile. It would appear that the impaction of the stone in the outlet must be dependent on the simultaneous occurrence of certain conditions which, as a matter of fact, seldom coincide. In the case of larger stones the contraction must be supposed to be of such a short duration as not materially to raise the bile pressure, or to the fact that the stones leave, or have between them, sufficient space through which the bile can pass.

Perhaps the most interesting point in the treatment of gallstones is the attitude of the surgeon towards the removal of the gall-bladder, which has become the favourite operation at the present moment. The propriety of this removal turns largely on the question of where gallstones are manufactured. If one could be sure that the only place for the birth of such stones were the gall-bladder, it would be rational to remove this in every case, if it were at all diseased. On the other hand, if any belief in the origin of stones in other passages is held to be possible, the removal of the gall-bladder cannot be advocated as a sure method of preventing the recurrence of trouble.

As time goes on it is becoming more obvious that cholecystectomy in a certain number of cases is still followed by symptoms of gallstones in the common duct. It might be advanced that such recurrences are due to a defective first operation, the surgeon having failed to detect the stones, or to take adequate measures for their removal or to aid their escape. If this be the explanation of the cause of the recurrence it is certain that such a failure follows the operation of cholecystectomy done by surgeons of experience and repute. This being admitted, it seems to be arguable whether the removal of the gall-bladder should be a routine measure, as by its removal a subsequent exploration of the common duct is rendered much more difficult and a valuable

means of draining the gall-passages in some other contingencies is lost. There are certain conditions, such as a small and shrunken organ, in which the gall-bladder is obviously useless for any further purpose, and under these conditions removal is the best; but the question will have to be settled in the future as to whether in the milder cases of disease it is not better to leave it or drain it by an anastomosis to the small gut.

As to the methods of exploring the common and hepatic ducts with a view to ensuring the absence of gallstones, it is very doubtful whether we have any method, either by palpation or duct exploration, which is infallible. The procedure of dilatation by sounds of the sphincter of the duct, which is practised by surgeons with a view to facilitating the passage of small stones, is in itself a confession that the discovery of all the gallstones present cannot be ensured by the method of exploration in use. It is also to be remembered that the effect of such a dilatation can only be temporary.

The question of drainage after removal of gallstones is also of importance, for the infection of the gall-passages is believed to be a cause of the formation of gallstones. It is reasonable to suppose that, after the removal of the diseased gall-bladder, a period of drainage is the best way of restoring a healthy condition of the mucous membrane. The same can also be said of drainage of the common duct after removal of stones from this position.

Obstruction produced by growth or inflammation of the head of the pancreas, which is, with the exception of a stone impacted in the ampulla of Vater, the most undoubted form of obstructive jaundice, is remarkable in that the symptoms are so different from those produced by gallstones. Almost invariably the jaundice is painless, persistent, and progressive. In the early stages the bile passages and gall-bladder are

enormously distended with bile, which later on is replaced by mucoid secretion. There may be difficulty in diagnosis between a small stone and a small nodule of carcinoma, which can only be settled by actual exploration with the knife. In the second place there is a difficulty in diagnosis between carcinoma and chronic pancreatitis, and the occurrence of chronic pancreatitis was partially, at all events, recognized by the unexpected restoration to health of a patient who had been condemned to death by carcinoma of the pancreas. As a matter of fact, cases of chronic pancreatitis producing jaundice seem to be much less to the fore than they were a few years ago, and it is quite probable that the earlier operations on gallstones and the restoration thereby to health of the bile-passages is the cause.

When the surgeon is faced with a huge gall-bladder and distended bile passages, great temporary relief and improvement of health can be produced by drainage of the gall-bladder. External drainage is now abandoned, and it is only a question as to whether the gall-bladder should be anastomosed to the stomach or the duodenum. It does not appear to matter which of these organs is selected for the opening as, somewhat contrary to expectation, the discharge of bile into the stomach seems to produce no disturbance of digestion. So it comes about that the surgeon can choose the stomach or duodenum, according to which organ offers the easier operation.

In the case of growths involving the upper bile ducts, the surgeon, unfortunately, is unable to offer any relief.

Gallstones.

By R. P. ROWLANDS, M.S., F.R.C.S.
Surgeon to Guy's Hospital, etc.

GALLSTONES are very common and cause much unnecessary suffering and far too many deaths from infection, suppuration, peritonitis, jaundice, pancreatitis, intestinal obstruction, and cancer of the gall-bladder and its ducts due to chronic irritation. Dr. Hurst states: "In at least 10 per cent. of all people over the age of twenty, gallstones are found after death, so that there must be over four million people in England who have gallstones now, or will have them before they die." It is commonly said that gallstones frequently do no harm, and this statement is based on the frequency with which they are found at post-mortem examinations of people who have died from other causes, but, as Thomas Coe wrote in 1757 in his "Treatise on Biliary Concretions": "What pain a patient may have felt from them cannot be guessed from viewing the body. A mere anatomist therefore knows but little of the effect of gallstones."

Why do gallstones form, and why are they more common in women, and especially in women who have had children?

The formation of gallstones is due to the following:—

(*a*) Infection, which occurs chiefly through the blood stream by bacteria carried from septic teeth, tonsils, and appendix, or from general infection such as enterica. Sometimes the infection spreads through the lymph channels from neighbouring viscera, such as the duodenum or stomach; occasionally it ascends along the ducts, especially in those people who have no acid in their gastric juice to sterilize the contents of the stomach and duodenum. Bacteria are excreted in the bile and are found in it, and also in the wall of the gall-

bladder. The commonest organisms are streptococcus, *Bacillus coli*, and the typhoid bacillus.

(*b*) Excess of cholesterol in the blood and bile. In nearly four-fifths of the cases gallstones occur in women who have had children. McNee has shown that during pregnancy the amount of cholesterol in the blood may be more than four times the normal. This forms chiefly in the corpus luteum both in pregnancy and during menstruation. It also forms in the suprarenal cortex, which undergoes active changes during these physiological processes. An excess of cholesterol also results from improper foods and insufficient water, especially during pregnancy.

(*c*) Stasis of bile in a pendulous, flabby, or obstructed gall-bladder, associated with a weak abdominal wall—a condition more often found in women.

Volvulus of the gall-bladder, kinking, torsion or stricture of the cystic duct are also occasional causes of the formation of gallstones which I have personally found, and the drag of a movable right kidney has been known to obstruct the cystic duct.

Here it is important to allude to the peculiar anatomy of the bile ducts and especially to the narrowness and tortuosity of the cystic duct, whose diameter is less than one-tenth of an inch and which also possesses a spiral valve which still further impedes the flow of bile or the passage of small stones. This is the reason why gall-stones very rarely reach the common bile duct except late in the disease as a result of the gradual inflammation and dilatation of the cystic duct. The duodenal papilla is also very small, and a stone impacted at this point often leads to death by obstructing the flow both of bile and pancreatic juice.

SYMPTOMS.

1. *Gallstones in the Gall-bladder.*—(*a*) These are chiefly the "inaugural symptoms" of Moynihan, and

consist essentially of flatulent dyspepsia, which is capricious, irregular, and intractable (thus differing very markedly from gastric dyspepsia), a dull pain and tenderness in the right hypochondrium, vertigo, headache, and "rheumatism." (*b*) Occasional attacks of subacute colic with nausea and vomiting, especially after exertion, and often attributed to hysteria or gastritis arising from indiscretions of diet. I know a lady who had had many miscarriages following attacks of vomiting due to this cause. Ultimately jaundice fortunately developed and was followed by the removal of 232 gallstones, which cured her. She has had no more miscarriages, but two living children since the operation.

2. *Cystic Duct Stones.*—Stones in the cystic duct cause sudden and violent colic in the right hypochondrium running back to the angle of the right scapula, intense restlessness, collapse, pallor, sweating and shivering, a slow pulse, nausea and vomiting. There are tender areas in the right epigastric angle and along the right costal margin; also in the back and flank along the distribution of the 7th, 8th, and 9th intercostal nerves and along the corresponding dorsal spines, as has been pointed out by Dr. J. A. Ryle. Recurrence of these attacks without jaundice is characteristic of stones in the cystic duct. Cessation of the colic does not necessarily mean that the stone has either passed or fallen back into the gall-bladder. Often an enlarged and tender gall-bladder can be felt during and after the attack.

3. *Stones in the Common Bile Duct.*—Here the symptoms are severe colic associated with jaundice and a tender area over the common bile duct. The attacks are intermittent or remittent. Sometimes nausea may replace the pain and, in other cases, there may be colic of short duration without jaundice. I have known one

lady who had attacks of pain about once a fortnight for seven years without any jaundice. She had previously had her gall-bladder removed, and at the second operation, to which she at last consented, three stones were found in the common bile duct.

DIAGNOSIS.

The diagnosis is not always easy, for cholecystitis may be mistaken for appendicitis (especially when the appendix is placed high up), and for renal colic or gastric or duodenal ulcer. In differentiating cholecystitis from peptic ulcer it is important to note that biliary dyspepsia has no time relation to food, and that there is achlorhydria in at least one-half of the cases; there is very rarely hypochlorhydria. On the other hand, with duodenal ulcer, over-acidity and hunger pains are almost constant.

X-ray examinations are valuable in excluding the evidence of duodenal or gastric ulcer and occasionally in showing the shadow of gallstones. Case and Carman maintain that they can show 50 per cent. of gallstones. More important is the direct X-ray evidence showing distortion of the gastric or duodenal shadows from adhesions drawing the latter up to the right, or from the pressure of the distended gall-bladder denting the shadow of the duodenum or pyloric antrum. Examination of the duodenal contents, by means of a Ryle's tube, often helps, for pus cells were found in 58 per cent. of cases examined at New Lodge Clinic, and cholesterin crystals in 50 per cent. When stones obstruct the bile ducts, however, this evidence is not available. Excess of cholesterol in the blood is also of some value, for more than 0·15 per cent. affords additional evidence in support of gallstones. Gallstones in the common bile duct causing jaundice have to be distinguished from hydatids, cirrhosis of the liver and cancer of the liver, of the ducts or of the head of the pancreas. It is the

association of jaundice with definite and severe colic which is so characteristic of cholelithiasis and distinguishes it from all these other conditions. The absence of a palpable enlargement of the gall-bladder is also important, for this is rarely found when the attacks are due to gallstones, except in those cases in which blockage of the cystic and common bile duct co-exist. In two cases I have known hydatid cysts block the common bile duct and cause symptoms similar to those of gallstones. The real disease was discovered at the operation and, in one case, I successfully shelled out the parent cyst from the upper surface of the liver. The patient was well when heard of some ten years later. With cirrhosis of the liver the jaundice is less marked, but there may be much pain due to perihepatitis and the characteristic history of alcoholism may be denied. With growth and with chronic pancreatitis there is usually more wasting associated with deeper, more intense, and more persistent jaundice.

PREVENTION.

Those predisposed to gallstones (and there are families so predisposed) should avoid foods which are known to be rich in cholesterol, and this is especially important for women in the latter months of pregnancy and the earlier months of lactation, as pointed out by Hurst. For instance, it is important to avoid eggs, brains, liver, kidney, sweetbread, fats and excess of butter. In the medical treatment, dieting along these lines also helps, and the use of antiseptics, such as sodium salicylate, grs. x to xx, three times a day, for months at a time. Urotropine is, however, the best antiseptic, as proved by Hurst, who gives up to grs. lx or grs. lxxx the last thing at night, together with grs. lx of potassium citrate to prevent irritation of the bladder. This is given on five days a week, but is stopped at once if any cystitis or hæmaturia is noticed.

He also gives mag. sulph., drachm i to iv, half an hour before breakfast, for this drug has been shown to cause rapid evacuation of the gall-bladder and the bile duct. Moderate exercise is of value, but violent exertion may bring on colic. Olive oil and belladonna may relieve the gastric symptoms chiefly by diminishing gastric acidity and allaying pain.

OPERATION.

I do not propose to enter into any details of technique, but rather to draw attention to the most general principles. Operations for gallstones are very difficult and should not be undertaken lightly. The anatomy of the ducts is intricate, especially when the parts are inflamed, and it is easy to injure them seriously. Anyone who undertakes this work should train himself thoroughly under a master. The main ideals are to do no harm and to remove all the stones, for gallstones very rarely re-form. Operations for gallstones, well done, carry a mortality of less than 1·5 per cent. for cholecystostomy and cholecystectomy, and 2·5 per cent. for choledochotomy, but this may be raised to about 15 per cent. when jaundice, and especially cholangitis, are present. Whenever possible, if the disease is limited to the gall-bladder, especially in young persons, it is important to remove rather than to drain the gall-bladder. If the cases are well chosen the mortality for cholecystectomy is less than that for cholecystostomy, and the after-results are infinitely better. It is important not to operate upon the common duct during an acute attack of jaundice and especially of fever. It is much safer to wait for an interval and to prepare the patient adequately. The risk of death in this case, from hæmorrhage, liver shock, suppuration, and cholæmia, is very real. Preliminary careful preparation, with injections of calcium chloride with plenty of water, and glucose by the rectum, adds greatly to the safety of the patient.

An Interesting Gall-Bladder Case.

By GEORGE ROBERTSON, F.R.C.S.
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THE interesting points of the following case may be put down thus:

1. The great size of the gall-bladder, with its very thick wall.

2. The very large stone impacted in the neck of the viscus. A few stones of greater size are recorded; these are reported by Sir J. Hutchison, Sir J. Bland-Sutton, and Sir Berkeley Moynihan. This stone must, however, rank with them.

3. The large fistula existing between the gall-bladder and the duodenum, allowing of a to-and-fro movement of fluid between the gall-bladder and the duodenum, thus explaining the variation in size and tension as observed in the tumour before operation, and causing some doubt as to the exact diagnosis previous to the opening of the abdomen.

4. The relationship between the infected gall-bladder and the multiple arthritic condition.

Mrs. B., aged 68, was referred to me by my colleague, Dr. Jones, who had found her suffering from a large abdominal tumour. I found upon examination a large, firm, elastic swelling occupying the right hypochondrium, right lumbar, and part of the right iliac regions. Bulging on all its palpable aspects, it was very pronounced anteriorly, laterally, and posteriorly between the costal margin and the iliac crest very distinct. It was tender on pressure. Colonic resonance could be detected on its anterior and medial aspects. Its dullness was continuous with that of the liver. The patient gave a history of intermittent passage of large quantities of pale urine. During four days of observation the tumour was found to vary somewhat in size and tension. The urine contained no abnormal constituent. Her general appearance was unhealthy and

somewhat anxious. Many joints showed rheumatoid arthritic changes, which had been under treatment in an institution immediately previous to my consultation with her own doctor upon her arrival home. The diagnosis lay between a very much enlarged gall-bladder and a hydronephrotic right kidney.

I operated by a vertical incision through the right linea semilunaris, and found, after separating several adhesions, a very large gall-bladder distended to half the size of the adult head. On its inferior and deep aspects this tumour was densely adherent to the neighbouring structures. The fluid content of the swelling having been evacuated without soiling the peritoneal cavity, a large incision was made into the sac. The wall of the viscus was found to be nearly a quarter of an inch thick. Its remaining content was a dirty, grumous, viscid material, which, like the fluid already evacuated, showed no trace of bile. When the sac had been thoroughly cleansed by swabbing, a large fistula, admitting two fingers, was found between the gall-bladder and the second duodenum, near its junction with the first duodenum. The neck of the gall-bladder, which could only be explored from within, was found to embrace a very large, firmly-impacted stone which was, with difficulty, removed. It was of a dark-brownish black colour, and weighed 2 oz. 30 gr. Almost immediately following its removal bile flowed freely into the gall-bladder.

To have attempted the ideal operation of cholecystectomy in this case would probably have been disastrous, even if it had been possible. The feeble condition of the patient, who stood the anæsthetic badly, the density of the adhesions, and the presence of the fistula, all determined the less severe operation of removal of the stone, thus leaving the gall-bladder to collapse and drain. As the patient showed no jaundice, and gave no history of jaundice, I felt fairly comfortable with regard to the condition of the common bile duct. No pyrexia existed before or after the operation. A large, non-fenestrated rubber tube was used to drain the gall-bladder, instead of the usual No. 12 Jacques' rubber catheter. Bile drained freely for over four weeks following the operation, after which the tube was removed. A smaller quantity of bile discharged into the dressings for about a week more. Then the external wound healed, and no further trouble or inconvenience was suffered. The patient made an excellent recovery.

The Treatment of Exophthalmic Goitre.

By T. GILLMAN MOORHEAD, M.D., F.R.C.P.I., D.P.H.
Physician to Sir Patrick Dun's Hospital, Dublin; Regius Professor of Physic, Trinity College, Dublin; Late Censor and Examiner in Medicine, Royal College of Physicians, Ireland, etc.

THE prognosis and the treatment of exophthalmic goitre may be considered practically together, inasmuch as the results of the latter can only be judged by a knowledge of the former. Graves's disease has been defined as a disease from which no one ever recovers, and of which no one ever dies. The aphorism is useful, though like most aphorisms it overstates the facts. In cases untreated, or treated only by the inadequate medical methods in vogue up to about twenty years ago, about 10 per cent. of deaths is recorded as a result either of the disease itself or its immediate complications. The death rate in England varies from 5·5 to 21 per million living, in different counties, according to Campbell. In all Ireland it is about 7·5 per million living. On the other hand, a considerable percentage of cases get well either without treatment or with rest and symptomatic treatment alone. This number has been estimated at as high as 50 per cent., but the time required for recovery is usually to be measured not in months but in years; although it will be admitted by all who have had much experience of the condition that occasional rapid and even sensational recoveries are encountered. The remaining 40 per cent. of cases drag through a life of persistent invalidism, with perhaps recurrent crises, during which they are of necessity confined to bed; at their best they are always easily recognizable as obvious

cases of hyperthyroidism. It is plain that one can only claim that a method of treatment is of value if it leads to a definite improvement in the above quoted figures.

What symptoms, then, are we to pin our faith to, as evidence that our treatment is doing good, and that recovery is in progress? Gain of weight is the first and most important. When successful treatment is inaugurated, the weight soon steadies, and in a few weeks begins to go up. Until an increase is registered, one cannot feel satisfied that progress is being made. Secondly comes diminution of tachycardia. But even under the most favourable circumstances the heart of a once hyperthyroid patient may continue, perhaps for years, to be more sensitive than the normal to emotion and other stimuli. The rate of basal metabolism also diminishes, but I purposely put this third, instead of first, as except in hospitals it is not always easy to have the necessary estimations made.

Frequently in otherwise cured cases some goitre persists: this is unimportant except from the æsthetic point of view, but it is important at the beginning of treatment to warn patients of the fact, as some are inclined to look on the goitre in itself as being the disease, and fail to regard themselves as cured as long as even a trace of enlargement is left. These patients may be consoled by the reflection that the most famous and beautiful female statues in the world all show a distinct thyroid fullness. It is well also to remember that if the exophthalmos has been present for more than six months, it may not completely disappear, though, as a rule, even in very chronic cases it diminishes considerably. In the process of recovery, tremor, sweating, and all other symptoms not especially mentioned, generally lessen *pari passu* with gain in weight.

I come now directly to the question of treatment. The first point to decide is between medical and surgical methods, and the decision must depend on the

results. But in discussing these results, it is essential that we confine our attention to recent methods. Admittedly up to twenty years ago medical treatment was extremely unsatisfactory. Some enterprising surgeon has indeed stated that, in the literature of the subject, over three hundred different drugs are claimed to produce perfect and almost immediate cures, and laughs at the credulity of physicians who can tolerate such absurd statements. But I am now talking of treatments as they exist to-day, and, just as I myself refrain from quoting against present-day surgery such statistics as were collected and published by Klose in 1913, so I ask surgeons not to judge present-day medical results by those of the past. Klose, I may say, collected 1,126 cases operated on between 1896 and 1912, with a mortality ranging from 1·3 to 30 per cent. in the hands of different surgeons, and with a percentage of cures claimed varying from only 14·5 to 93·7 per cent. Such statistics may now be put on one side along with the three hundred medical cures alluded to. It will at once be admitted that while many drugs are useful symptomatically, none are of themselves curative. There are, however, one or two medical methods to which, though almost obsolete, I must nevertheless refer. Some years ago, when cytolysins were in fashion, the milk of thyroidectomized goats, and the dried blood of goats which had been injected with thyroid extracts, were extensively tried and widely praised. Personally, I never got any satisfactory results from their use, and my own experiments to produce an anti-thymic serum convinced me that cytolysins were easier to write about than to produce. My reference to the thymus gland reminds me that thymus extracts, adrenalin, and, more lately, parathyroid extracts have also been extolled. Here, again, I have been unlucky: I have seen no good results from the use of these substances. In general my conclusion is that organo-therapeutic methods have so

far completely failed, but it would be rash to assert that nothing is to be hoped for from them in the future.

Another modern medical treatment must next be considered. I refer to the administration of iodine, more particularly in the form of Lugol's solution, a method which has largely been brought into prominence by Plummer of Rochester. All here will remember the warning originally uttered by Kocher, Kretz, and others against the use of iodides in hyperthyroidism, and many of us must have been able to verify the fact that the incautious administration of iodides to adenomatous cases is capable of converting an apparently simple goitre case into one of undoubted Graves's disease of the toxic adenoma type. Personally it has happened to me not infrequently to be called into consultation in such circumstances, and to have subsequently seen improvement follow when the iodide treatment was stopped. In these circumstances I was at first slow to adopt iodine therapy, more especially as the results I obtain by other methods are so satisfactory. It may be added, moreover, that all that is claimed for this treatment is that it temporarily improves the patient's condition to such an extent that surgical treatment becomes simpler and safer. The actual method is, of course, based on the fact that the goitre in Graves's disease is deficient in iodine content, but whether this is due to its rapidly pouring into the blood its specific product, instead of storing it in colloid form, is as yet undecided. It is undoubted, however, that carefully regulated doses of iodine can lower the basal metabolism, can lessen the heart rate, and can cause an increase of the patient's weight. If too large a dosage is employed the patient gets worse, and if the administration is stopped immediate relapse may occur. It may be added that the English workers, Mellanby and Fraser, are much more restrained in

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their enthusiasm concerning iodine treatment than are the American and Continental workers.

My own present view, however, after six months' trial is that the administration of ten drops of Lugol's solution once or twice daily is not merely an important preliminary to surgical treatment, but is also of value in cases in which a medical course of treatment has been decided on. When iodine is given, improvement takes place more rapidly than formerly, and this improvement is later rendered permanent by the means to be described.

The methods which I myself advocate are in no way original, but I quite definitely claim that they can produce a cure of between 70 and 80 per cent. of cases within six months. In order to ensure success strict attention to detail is most important. What I advise is as follows:

(1) The patient must go to a nursing home for the first month: any attempt to carry out the treatment in the patient's own home is not likely to succeed. (2) During the first week the patient remains rigidly in bed, an ice-bag is applied to the thyroid gland for at least two hours daily, diet is largely vegetarian, sedatives are given at night if required, very few visitors are allowed, quinine bromide, five grains, is given three times daily, local septic foci are attended to, and intestinal stasis, if present, is got rid of by suitable means. (3) During the next three weeks the same regime is followed, except that each afternoon the patient receives an X-ray exposure to the thyroid and thymic region; the actual dosage is a matter for the radiologist; but I would like to emphasize the fact that only an expert radiologist should carry out the treatment. Twice I have seen in consultation cases that have been X-rayed by persons who were not experts; neither of these cases was in the very least improved as regards the hyperthyroid symptoms, and both of

them had X-ray burns. (4) After a month in the nursing home the patient is allowed to return home for a month. Life must be taken easily, not getting up till after lunch, and only going for short walks, but otherwise no other treatment is required. (5) After this month at home a second three-week X-ray treatment is carried out. For this treatment it is less essential to enter a nursing home, but if expense be no object it is advisable. This method of giving a second X-ray course, after an interval, is more effective in promoting cure than is a prolonged single X-ray course.

By the end of the first three weeks the patient is, as a rule, more comfortable. When the treatment is over there is generally an enormous gain all round, and by the end of six months from the beginning of treatment the patient should be perfectly well. The goitre as a rule becomes hard and fibrous, and the process of fibrosis may continue long after the treatment is finished. The advantages of this treatment are: first, that it is safe; and, secondly, that it gives as good (personally I maintain better) results as surgery.

Now, in attempting to support my statements by statistics I hope it will be remembered that the number of cases seen by a single physician in a small country are necessarily limited, and cannot in any way compare with the enormous numbers seen in some of the trans-atlantic clinics. It may, perhaps, be objected that the numbers I quote count for nothing without a short record of each case. To provide such records, however, would obviously be tedious, and, in consequence, I may say that when I speak of complete recovery in any given case, I mean real restoration to practically full normal health. Some of the cases that I refer to as complete recoveries are, for example, able to hunt, to win golf handicaps, and to run important businesses. They have all gained weight, are free from tachycardia, and in the few that I have been able

to get tested basal metabolism is normal.

In recording my cases I purposely leave out those treated in my general hospital, for various reasons, the chief being the difficulty in following up these cases. Of private cases I reported five cures out of six treated in 1914. Between 1914 and 1917 the busy times associated with the war prevented me from keeping accurate notes. Since 1917, up to the present date, I have treated under my own supervision, as distinct from cases seen only in consultation, exactly fifty-one private cases. Of these I have been unable to get recent information concerning four. Two out of these four are in England, and were doing well when I last heard of them.

This leaves 47 cases, but of these three had treatment for a very limited period only. Two of the 47 are still undergoing treatment, and here I may remark incidentally that during the last twelve months I have seen many fewer cases than in the preceding years, presumably due to the settled condition of the country now. Deducting the above-named five cases, I am left with a final number of 42 cases. Of these only one case is dead: this patient died in 1919, of influenzal pneumonia, just after her second course of X-rays. Two patients definitely did badly, in the sense that they showed no response whatsoever, and one of these after a third course of treatment became for a time acutely maniacal. Since writing this I have seen both of these cases. They are now in a much quieter stage of the disease. Of the remaining 39 I claim 32 as complete cures, and seven as very much improved. Two of these patients suffered from a relapse fifteen months and twenty-two months respectively after apparent cure, but both of the cases did well after renewed treatment, and now rank amongst my complete cures. These figures work out at 76 per cent. of cures, and about 17 per cent. much improved, and are,

I maintain, enough to justify one's reliance on medical measures. The alleged disadvantages of medical treatment are as follows:

(1) Expense: to the private patient the treatment is not more expensive than that of one or more operations.

(2) The time involved: to this I reply that, in my own experience, immediate good results after surgery are rare. My experience is, I admit, limited, but I have certainly seen cases not as well six months after an operation as after the treatment outlined above. Recovery from the operation must not be confounded with cure of the disease.

(3) I freely admit that results are harder to obtain in the hospital class of case than in private, owing to the difficulty of carrying out the essential details.

(4) It is stated that one cannot control the treatment, and that myxœdema may result. This very statement is in itself an admission that the treatment is a successful one. I have only met with one case in which myxœdema did actually develop.

This case was a curious one. A lady, well known to me, came to me some three years ago, and demanded thyroid tablets for obesity. Knowing her well in every way, I refused, as I knew that if I gave her a small dose, she would, in her desire for rapid results, multiply it ten-fold. She, however, obtained them elsewhere, and whether *post* or *propter*, I was next asked to see her in consultation some twelve months later, when she was suffering from typical Graves's disease. She made a very good recovery in less than six months, and was so impressed with the method that she sent me two similar cases. Later, when troubled times arose, she decided to live in England, and not feeling well while there, decided to have an X-ray course on her own account. She persuaded a radiologist to treat her, and all went well for a time; but last autumn I got a letter from a doctor asking me about her, and telling me that she had now developed symptoms of myxœdema.

Now, as regards surgical treatment, its varying methods and results, I do not venture to write. I am quite aware of the magnificent results obtained in some clinics, but I feel that the low mortality and the

success attained can only be expected under very special circumstances. If operations for this disease were performed only by those who are specially skilled and who have thoroughly equipped hospitals at their disposal, the total mortality might be almost negligible, but if surgical treatment is admitted as the treatment to be generally adopted, and if it is put in practice all over the country by general surgeons, I am convinced that the mortality will be high.

It has been suggested to me that exophthalmic goitre is a milder affection in Ireland than elsewhere, and that surgical treatment is less urgently required here because cases yield more readily to medical measures; but that in some countries it is such a dangerous malady that medical dalliance is out of the question, and that a kill-or-cure policy must be adopted.

I have no doubt that some surgeons will claim much better results than I can produce, and I freely admit that the mortality, though still by no means a negligible factor, is now much reduced. Surgeons naturally object to having only the very bad cases referred to them, but I can conscientiously state that, were I dealing with a relative of my own, I would unhesitatingly select medical treatment, unless the case were one of the severe variety; in such an instance I might hesitate. In this choice I am not alone. Hale White and other writers have emphasized the fact that the operation only too frequently is not a certain cure, and inasmuch as it is uncertain and is not safe, I prefer the course that is uncertain but safe.

Neither physician nor surgeon can claim that he is doing more than dealing with the cause of some of the symptoms, but till we know what leads the thyroid gland to hyperfunction no other course seems open.

Submaxillary Calculus.

By DUNCAN C. L. FITZWILLIAMS, C.M.G., M.D., Ch.M., F.R.C.S.

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CALCULI are not infrequently encountered in relation to the salivary glands. They are occasionally met with in connection with the parotid and Blandin's glands, but those in connection with the submaxillary gland are the commonest. The stone which is deposited from the secretion of the gland is chiefly formed of calcium phosphate with small amounts of calcium carbonate and magnesium, and about 5 per cent. of organic matter; it is whitish or whitish-brown in colour. The causes of the deposition of the calcium salts are probably those which favour the deposition of solids from the fluids in which they are suspended in other situations. Thus, stagnation of the secretion will help a high percentage of solids in the fluid either in response to special diet or to other cause, and probably, above all, to the presence of a nucleus upon which crystallization can take place.

In the majority of cases this nucleus is formed by inspissated mucus. There are several instances in the literature of secretion so thick as to be unable to find its way through the opening of Wharton's duct. We can imagine that a flocculus of mucus might remain in the duct and so form the starting point of a calculus. The following case is an example:

Mrs. C. M. complained of sudden laciniating pains in the floor of the mouth and in the tongue. The mouth could scarcely be opened or the tongue protruded. On raising the tongue a soft, rounded swelling was seen beneath it at the opening of Wharton's duct. Stone in the duct with pus behind it was diagnosed. The duct was opened and a solid mass came out followed by a gush of pus. The mass

proved to be a small stone surrounded by a substance resembling cooked macaroni. (Johnston.)

It is quite possible that bacteria may play a rôle in this matter, either finding their way in at the opening of the duct or being excreted by the gland. They are often obviously present soon after the stone has formed.

Foreign bodies which get into the duct by accident will also cause a deposition of lime salts, and thus cause the formation of a calculus. The following is a good example:

M.D., after having eaten a trout went to bed, but was awakened with swelling and pain of the right sublingual region. Poultices were applied, but he had a very uncomfortable feeling at the extremity of Wharton's duct, and kept making movements with his tongue as if to brush away a foreign body from the region.

Everything quietened down till three years later, when he had two other violent attacks of pain in the region. The tongue swelled and chewing became impossible. A surgeon passed a probe into Wharton's duct and felt a stone which he intended to remove next day. During the night, however, there was an excruciating attack of pain and, in making a movement with the tongue, the patient felt a prick. On examination a stone was seen and extracted. It was four to five lines long and half an inch in circumference, and had the appearance of a small sugar plum; it was long, rough, and white. In the centre was a fish bone which protruded at one end for a quarter of a line.

Other instances might be quoted. Thus Claudot reported a tailor who had a pig's bristle in the duct. Another case was that of a soldier who had a spikelet of corn, a central axis with four small leaves attached by thin pedicles, upon which salts had become deposited. The condition was termed an acute ranula. Bouillet mentions a man who was ill for nearly three weeks with pain and swelling of the tongue. Daily probing of Wharton's duct gave relief and let out the saliva for fourteen days, after which time a foreign body was believed to be present. An incision was made and a piece of straw found. In Closmadeuc's case a piece of straw was seen protruding from Wharton's duct.

In one of Hulke's cases a piece of woody tissue was found as a nucleus of one stone, after which others had

formed. Usually the stones form in Wharton's duct, but they may do so in the smaller ducts of the gland itself. Spencer reported a case excellently illustrating this:

A girl of twenty had pain and distension of Wharton's duct. On incision there was an escape of ropy mucus and small calculi like rice grains. The incision was kept open and more calculi escaped. When the incision was closed, the symptoms returned, and a second incision was needed, when more calculi were scraped out. Eventually the gland had to be removed. On section, calculi were found throughout the gland; they consisted chiefly of carbonate of lime and had to be dissolved before sections could be cut. There was dilatation of all the ducts, which were filled with inspissated mucus in which the carbonates were being deposited. (*Trans. Path. Soc.*, 1898, xlix, 85.)

The stones are generally single, but two or more may be present, so that grit or sand may be found throughout the ducts. The shape of the stone usually is that of a small date stone, or a long spindle, this being the cast formed by the mould of the expanded duct; sometimes, however, one end is thicker than the other.

Where there is more than one stone present the stones are often faceted. In size an ordinary date stone would be considered large, but this has often been exceeded. D'Arcy Power reported a stone which weighed 4·4 grams (63 grains), was an inch long and one and a half in circumference. It was only discovered after the submaxillary gland had been removed and the trouble had lasted for over forty years. Delery records a case where a calculus, 2 grams 16 centigrams (31 grains), was removed and the wound did not heal, so it was probed a month later, when another stone a little smaller than the preceding one was found. McCartan mentions a French priest in whom a painful swelling suddenly formed and eventually burst giving exit to pus, grit, and two long, rough calculi weighing between them 13 grams when dry, faceted where they had been in contact with each other. There had been no trouble till two days before, when suppuration threatened. Middaugh gives details of a case where the stones ulcerated

out of the duct and formed an abscess: the submaxillary gland was excised, and two stones found articulating by a ball-and-socket joint. The larger weighed 4·46 grams (64 grains), and the smaller 1·98 gram (28 grains). In this case the history was over 13 years. Puzey reported a case where the stone weighed 7·6 grams (111 grains), and considering its size, its weight was very small. The history was more than two years. In nearly all cases where the stone is large, its formation must have extended over a considerable time, but as in the case of the French priest mentioned above, there is no necessity for any symptoms to occur unless the stone moves forward and blocks the outlet of the duct in the manner of a ball-and-socket valve. Stones have been reported as occurring in the salivary glands of children. Wright mentions one in a child of nine, and Schenck records one in a child of seven, and another in a child of twelve.

SYMPTOMS.

The symptoms of the condition are very characteristic when they are well developed. There is pain in and under the tongue, and swelling in the submaxillary region at meal times. This pain may vary from mere uneasiness to pain so acute as to prevent eating, as eating always makes it worse. This can be understood, as the movements of the jaws and the presence of food in the mouth cause the reflex secretion of saliva. The flow causes the stone to move and block the mouth of the duct. The secretion can be formed against considerable pressure so that the tension rises and causes the pain.

On stopping the action of the jaws and the stimulation of food in the mouth, the secretion ceases and the pain gradually subsides. No pain may be felt for some days or weeks if the stone has passed back to a wide portion of the duct and does not cause a block; when pain and

swelling occur they may remain permanent for some days and then pass off, to recur at a future period. I have known of two such cases diagnosed as recurrent mumps, both of which were found to have a stone. If one kept in mind the fact that what one is inclined to diagnose as recurrent mumps is always due to a calculus in the salivary ducts it would be a help. Sometimes a swelling like a ranula may form with more or less pain and an unsuspected stone may be found on incising it. In other cases there has been no trouble till symptoms have suddenly appeared very acutely with great pain, tenderness on moving the tongue, and swelling of the submaxillary gland. This may pass on to abscess formation and the discharge of the stone. If the stone is not discharged a fistulous tract may form, and the stone may be found later, on probing the tract.

DIAGNOSIS.

The diagnosis of calculus may not be at all easy. The presence of a stone may be suspected, but it may be difficult to find, even on passing a fine probe down the duct into the gland. This can easily be done with patience, the difficulty being to enter the duct which opens at the apex of a papilla. In many cases the stone can be felt by putting one finger inside the mouth and the other hand under the jaw, and stroking the duct along towards the opening. In suspected cases in the out-patient department, I have several times given the patient something to eat, when the stone is washed along to the front of the duct and easily felt, or swelling of the submaxillary gland takes place. It is curious what a large stone can be tolerated by some people, while in others minute calculi may set up symptoms. The presence of a calculus should always be suspected if pressure on the floor of the mouth makes pus issue from Wharton's duct. Besides the diagnosis of recurrent mumps, which is sometimes made, I have

known ulceration due to a stone mistaken for carcinoma, and in the first case I ever saw this mistake had been made. The details were as follows:

The man was a porter in No. 6 ward of the Royal Infirmary, Edinburgh, while I was a resident. He had a soreness in the floor of the mouth for about a month, and ulceration had gradually appeared. On examining the sore something whitish was visible at the bottom. On touching this with a probe a stone was found. On removal it was exactly like a small date stone. The ulcer healed.

Diagnosis may also be very difficult when the calculus is far back in the gland or has become surrounded by a considerable amount of fibrous tissue, and the true nature of the case may only be revealed after excision of the mass involving the submaxillary gland. Kuttner reported five such cases, four of which had been diagnosed as carcinoma. As an offset to these, however, an error in the opposite direction, reported by Croste, may be quoted:

A French officer took to smoking a pipe in the trenches; he was a confirmed smoker and took in the smoke very hot. He developed a plaque of leucoplakia round the opening of Wharton's duct. This grew very hard and felt just like a small foreign body inside the duct. Pressure on the canal made a whitish fluid and debris come out of the duct, a calculus was diagnosed in consequence, and much time lost. Eight months later a gland was felt under the angle of the jaw. The condition proved to be a squamous epithelioma.

Sometimes an X-ray photograph will show the stone quite clearly.

TREATMENT.

Once the diagnosis of calculus is made the treatment consists in removing it as soon as possible. If the stone can be felt in the duct all that is needed is to infiltrate the tissues with a little eucaine or novocaine; too much should not be injected for the tissue easily becomes œdematous, and the stone, if small, may be lost. This happened to me once, and I had great difficulty in finding it. When sensation is abolished the thumb should be placed under the jaw and the forefinger in the mouth over the stone. This is more easily done on

the left side. An incision is made on the long axis of the duct, when the knife will be felt to grate upon the stone. Once the knife grates upon the stone the tissue should be divided for its full extent at once; if the knife is taken away the stone may not be found again easily. It must be remembered that blood obscures the view, and there is no room to swab. The stone should, if possible, be cut down upon, the tissues divided, and the stone turned out with a knife, practically in one movement. If a general anæsthetic is given, attention to these details is not so necessary. In some cases the canal can be slit up on a probe introduced into its interior and the stone expressed from the opening. In one case the stone could not be removed from the duct as the canal fitted closely round a waist-like constriction on the calculus.

The following cases are quoted as being instructive:

A woman, 22, was said to have a ranula, as she had a history of a six years' swelling in the floor of the mouth which subsided when there was a flow of saliva. The tumour was dissected out and a calculus found weighing 76 grains. It was trihedral, one side smooth and hollow, the others rough and convex. In its centre was a black fragment of woody tissue, with concentric rings round it. Six years later she was admitted with an abscess in the neck and discharging sinuses. She had been well for four years, and then an abscess had broken and some small stones discharged. After a year the abscess had healed, but had formed again three months later, and had not closed since. An opening was made and a calculus 1·5 by 1 cm. was removed. Seven years later she was admitted again; she had been well for four years, then abscess had formed, and stones had been discharged. She now had all the side of the neck inflamed. This time two calculi were removed, the larger being the size of a haricot bean (Hulke).

M. S. complained for about three years of pain and uneasiness on eating, which were getting worse. Calculus was suspected, but nothing could be felt even on probing the duct. At last, after having eaten something, a small mass was felt. A local anæsthetic was injected and an incision made far back over the duct. Two small stones were removed. The patient had great pain and swelling for some days, and the pain only gradually disappeared. The cause of this pain was unknown, and left in the mind the possibility that a piece of stone might have been left behind. Later, he passed a small amount of grit, and still sometimes experiences an uneasy sensation in the region.

Frequency of Micturition in Infancy and Childhood.

By DONALD PATERSON, B.A., M.B., M.R.C.P.

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IN infancy the diet is fluid and the quantity taken in and excreted as urine requires a frequent emptying of the bladder. The normal infant passes water after each feed and once or twice during the night at least. As the child's diet becomes of a more solid and less fluid nature the quantity of urine and need for micturition become less. By the age of eighteen months to two years control of the bladder and normal spacing of the periods at which micturition should take place, are firmly established.

Frequency, therefore, is not pathological in the young infant, both for reasons of diet and training.

From one month onwards an attempt should be made to teach the infant to control the bowel and bladder. Immediately after each feed the infant should be placed on the chamber in order to establish an association in its mind between the passing of its urine and the feeling of the chamber on its buttocks. To help this some nurses in addition croon or hiss so that the child has an auditory association as well as its tactile one. Gradually this association becomes firmly fixed in the infantile mind, so that it fails to pass its urine unless the usual procedure is followed. The time at which this is accomplished varies greatly. The fidelity of the nurse or mother to her duty and the nervous control of the individual infant are the chief factors. Once this association is firmly established and properly maintained the problem of bed-wetting does not arise.

The causes of frequency may be divided into those where the bladder or urine are definitely at fault, and those where the training or nervous control of the bladder has either never been firmly gained or has been temporarily lost.

Frequency of micturition is of course associated with a cystitis or stone in the bladder as in adult life. But this is an extreme rarity. The urine, however, should always be carefully examined and the presence of pus or organisms excluded. An X-ray of the bladder is seldom necessary to exclude stone with a normal urine. A strongly acid urine will occasionally produce frequency and a drachm of citrate of potash or bicarbonate of soda in the day will set this type of case right. Again, the amount of urine passed may be great, so that diseases such as interstitial nephritis and diabetes insipidus or mellitis must be excluded. Careful urinary and physical examination with inquiry into the habits of the child will soon exclude these.

In one child aged one year, the mother complained of frequency and the fact that drinks of water were demanded day and night. The child was admitted to Great Ormond Street Hospital as a possible case of interstitial nephritis for observation. Drinks were withheld at night and given at regular intervals during the day, with the result that the diuresis ceased and normal urinary and drinking habits were obtained in a few days.

In cold weather it is a usual experience that a diuresis occurs, with a result that a tendency to frequency is most common. In very warm weather the exact reverse pertains.

It is a fact with which most observant mothers and nurses will agree, that during the actual piercing of the gum by a tooth many children have some degree of frequency. The explanation of this is not an easy matter. At this period the child tends to have anorexia and to take very little solid food, and more fluid is drunk in consequence, hence the more frequent urination. The urine, in addition, is more acid at this time,

which may also contribute to the frequency.

Having definitely excluded inflammation of the bladder, stone in the bladder, strong acidity of the urine, and a tendency to the passage of too great a quantity of urine, it should be assumed that the fault lies in the nervous control of the bladder. Some children are allowed to pass urine at too frequent intervals, and are either constantly wet or constantly asking for the chamber. In such cases it is necessary to measure the quantity of urine passed on each occasion throughout the day. The bladder of the child from one to three years should be capable of containing from three to six ounces of urine. If therefore a few drachms only are passed on each occasion it becomes quite clear that the bladder is being only partially filled. An attempt now should be made with the co-operation of the mother or nurse to lengthen the periods between micturition. This cannot be done successfully unless the child will ask for the chamber, and a preliminary course of training may be necessary to get the child to associate the chamber and the passage of its urine. Once the child will ask he must be kept interested and employed as the time approaches when micturition is expected, and the bladder, which has become small and contracted, will thus be allowed to fill to a greater and greater extent. The child's discomfort at waiting tends to pass off and it becomes clear to him that the urine need not be passed immediately the feeling of fullness occurs. Great tact is required in bringing this about. If too much attention is drawn to the frequency, if it be discussed in front of the child and he be reproved for it, then it will undoubtedly assume undue importance. He soon finds out that the household is upset and alarmed and he has become the centre of the stage. Properly managed, no apparent notice is taken of the frequency, and a quiet optimism should pervade the home, the child being praised when any

improvement shows itself. Any mention to the child of his failing should be one of encouragement and not reproof. A normal child may suddenly develop frequency after an illness if the diet has been fluid, necessitating frequent emptying of the bladder. In his run-down, debilitated condition, this acquired frequency is often maintained and can only be set right by tonics, attention to the child's general health, and change of air, together with careful management of his habits of urination.

The nervous child may show recurrent bouts of frequency from time to time. It will be noted that these bouts coincide with periods of great excitement, such as Christmas, birthdays, change of nurse, etc. For instance, a child who is taken much notice of at the tea-hour will often show marked frequency as the result of the nervous strain. It is then essential to avoid this excitement. Our medicinal sheet-anchor in these cases is belladonna or atropine. This drug, acting as an anti-spasmodic, allows the wall of the bladder to relax and therefore to hold more urine. The period between micturition is lengthened, the confidence of the child in himself is restored, and the mother or nurse is filled with the great tonic, namely, optimism. The child sleeps better and once the vicious circle is broken he rapidly becomes normal. Five drops of the tincture of belladonna, given three times a day, well disguised in syrup of orange, should be the initial dose. If extremely nervous, two or three grains of potassium bromide may be given at the same time. This dose of belladonna is suitable for the average child up to the age of three years.

In a large series of cases of enuresis it was noted that frequency occurred in the daytime in three out of every four cases.

No mention has been made of the mentally defective child or the child with organic nervous disease. Certainly in the former much can be accomplished by faithful early training.

The Diagnosis of Peptic Ulcer.

By CECIL BULL, M.B., M.R.C.P.
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CHRONIC gastric and duodenal ulcers are common lesions, and, when successfully diagnosed, may be among the most satisfactory groups of cases in abdominal surgery. But the pre-operative diagnosis is often very uncertain and is made with so little confidence, that operation is performed for diagnostic purposes. This is an even more uncertain method, which may amount to a surgical disaster, for, in a few cases a lesion is found and successfully dealt with, but too often nothing abnormal is seen, a harmless appendix is removed or, far worse, a gastro-jejunostomy is put on to a stomach reflexly disturbed by extra-gastric irritation.

In terms of moderation, operation for diagnosis is a hazardous undertaking; necessarily so when it is understood that gastric symptoms may arise from an area of irritation anywhere within the length of the alimentary tract, and indeed from almost any of the abdominal viscera. Having also seen a number of cases in which gross pathology has been overlooked at such operations, I can never consent to the exploring of an abdomen with chronic symptoms in the absence of a definite diagnosis.

Such a hazard might justifiably be undertaken in the interests of the patient if a pre-operative diagnosis could not be made, but it is the object of this paper to show that the diagnosis of peptic ulcer of the stomach or duodenum can and should be made with an accuracy of not less than 90 per cent.

And it is not only for the surgeon that accurate

diagnosis is essential, for it is waste of time to treat a case medically for peptic ulcer unless the diagnosis is reasonably or absolutely certain. Nevertheless, many patients have been so treated for years on the strength of a single hæmatemesis or other suggestive symptom—which may or may not have been due to peptic ulcer.

The diagnosis is made on a careful review of the evidence obtained from (1) history, (2) physical examination, (3) X-ray examination; and it is more satisfactory if the physician himself can make all of these examinations.

There are other tests which may be used. The test for occult blood in the stools is often useful. A blood count may be necessary, and also bacteriological examinations in a few cases. There is also the test meal and the fractional test meal from which certain deductions may be made, but the evidence obtained is worth so little in comparison with other methods that I have now abandoned it as a routine practice.

HISTORY.

The so-called "typical" history of peptic ulcer is very valuable when it can be obtained, as it can in about 40 per cent. of ulcer cases, but it is impossible and therefore unwise to make a diagnosis on the history alone.

The late Dr. B. W. Sippy used to say that every case of gastric or duodenal ulcer showed the same characteristic symptoms and signs which could always be shown to be present if enough time and patience were given to the investigation. In fact, Sippy admitted every case to one of his hospitals and refused to allow the diagnosis of peptic ulcer until these characteristics—which he called "the five clinical facts"—had been proved. They are:—

(1) That the onset of pain or discomfort is from one half to four hours after a full meal.

(2) It is relieved for a similar period by a full meal.

(3) It is relieved by an adequate (neutralizing) quantity of alkali.

(4) It is relieved by completely emptying the stomach.

(5) The gastric acidity is increased both quantitatively and qualitatively during the height of pain.

Every case of peptic ulcer can, as Sippy showed, be made to exhibit all of these five clinical facts. But in many cases one or more of these points comes out in the history and, although such statements cannot be accepted in the same way as they could under clinical observation, yet they are very valuable, and in most cases it is unnecessary to put them to proof.

The history of gastric and duodenal ulcers is the history of long-standing bouts of pain or discomfort in the epigastrium. It is significant that most patients will point with one finger to the seat of discomfort or pain, whereas the reflex dyspepsia patients pass the whole hand across the epigastrium with no certain localization.

A special characteristic of the symptoms of peptic ulcer is the tendency to remit and relapse, until finally the symptoms become continuous with no remissions at all. The relapses tend to occur in the spring and autumn with the change of seasons, and many patients enjoy such long periods of remission in the early years, that they do not seek advice until they have an unusually long relapse or a sudden hæmatemesis.

Pain may radiate from the spot indicated by the finger. It may radiate across the epigastrium, up into the thorax, or through to the back, the latter being frequently observed in penetrating ulcers adherent to the pancreas or liver.

In character the pain is described as sharp, aching, gnawing, or burning, or it may not be a pain at all—only a sense of discomfort or dragging in that situation which, by its constancy in recurrence and position, causes the patient to complain.

It is a valuable point to remember that some

abdominal discomfort with peptic ulcer is invariable. I have heard of cases which have never had a symptom, and I have had the opportunity to question many of them, and I have never yet met a case from which by careful questioning one can elicit no history whatever.

The qualitative effect of various diets is not very constant, but it may often be noted that pain is severe after a meal of cereals. Mineral acids excite pain. Sugar and alcohol give temporary relief.

Physical exercise brings on an attack of pain sooner than if the patient rested after meals.

"Clinical facts" (1) and (2) are illustrated by the patient's statement that there is always a period of varying duration after a meal when the pain or discomfort is absent. In gastric ulcers this relief is often not for more than half an hour, and in penetrating gastric ulcers with peritoneal involvement it may be but partial, and the admission is obtained only by careful questioning.

(3) Patients rarely take enough alkali to neutralize the acidity of the gastric contents, but all patients with gastric or duodenal ulcers have discovered for themselves or through their doctors, that soda, or bismuth and soda, gives some relief.

(4) Is illustrated in the history by the statement that vomiting when the pain is at its height gives relief. Vomiting does not necessarily empty the stomach completely, but it is also associated with regurgitation of the alkaline contents of the duodenum and the remaining gastric acidity is considerably lowered.

A stomach or duodenum with peptic ulcer never gives pain when the stomach is completely empty. I know of only one exception to this rule, namely, that a gastric ulcer with peritoneal involvement may cause a constant, dull ache from the pull on peritoneal adhesions during peristalsis and respiratory excursions.

This "clinical fact" gives us another valuable point

in diagnosis, for, whereas pain which awakens the patient in the early hours of the night—when the stomach is emptying and the acidity is high—is a very characteristic symptom; pain on waking in the morning is never due to peptic ulcer, unless that ulcer has given rise to obstruction of the pylorus or duodenum, with consequent retention in the stomach of the over-night meal. In this case the other signs of obstruction, for example, visible peristalsis, copious, infrequent, fermenting vomits and the X-ray evidence, will be obtained.

The fifth "clinical fact" can be proved if desired by taking a routine test meal in the morning and a second test meal during the height of pain, and comparing the acid values in the two cases. It will be found that there is an increase of hydrochloric acid, both in quantity and per cent., in the second test meal.

Hæmorrhage occurs in about 25 per cent. of all cases. Moynihan gives 18 per cent. to 20 per cent. for his cases of gastric ulcer, Mayo gives 20 per cent. The incidence of hæmatemesis is proportionately greater in gastric ulcer, as is melœna in ulcer of the duodenum.

In a history of peptic ulcer all of these symptoms may be elicited, or perhaps only one or two. The histories of duodenal ulcer are usually the more characteristic and often attain the "typical" to which many observers have directed attention. In a gastric ulcer history the facts are there just the same, but the time occupied in the sequence of events is shorter, and the patient is often confused, or not very observant, as to when the pain begins and ends. There is also the difficult group of cases with peritoneal involvement from deep penetrating ulcers, but, fortunately, in these cases where the history is weak the X-ray signs are unmistakable, and the diagnosis should never fail.

A good history may be a real help, a bad history very little help; but in neither case is one ever justified in

making or rejecting a diagnosis of peptic ulcer on history alone.

PHYSICAL EXAMINATION.

The physical examination is a necessary routine and is essential if only to exclude other conditions, and to estimate the patient's general condition in view of the treatment that will be adopted. The positive evidence is likely to be small. Such evidence is: (1) visible gastric peristalsis, indicating pyloric or duodenal obstruction; (2) palpable abdominal tumour. In both cases these signs will be confirmed by X-rays. Localized tenderness is often present but is by no means diagnostic of ulcer. Several observers—after the stimulus of the late Sir James Mackenzie—have studied the distribution of cutaneous hyperæsthesia, but I have found it an inconstant guide and of little practical value.

X-RAY EXAMINATION.

This is the most important single method of examination, and in a high percentage of cases can make a positive diagnosis unaided. But it is a mistake to suppose that anyone can make an accurate interpretation from seeing a few single films taken at comparatively long intervals. It cannot be done, and I believe that it is because of this method that radiology is denied by many the place it deserves in gastric diagnosis. Whenever I hear complaints of the inaccuracy of X-rays in abdominal diagnosis I find that this is the method that has been used.

There are two accurate methods which are equally satisfactory in their results.

1. The serial film method. In this, which is the method advocated and used by L. G. Cole, films of the barium-filled stomach and duodenum are taken in rapid succession, and thus, any diagnostic abnormalities which are present appear in most or all of the series

and remain constant, although the form of the stomach and duodenum is continually changing. I have but one objection to the method—the objection of expense; for it uses a great deal of material—as many as two or three dozen films in most cases.

2. The fluoroscopic method. The lesion or the indirect signs of the lesion are seen under the fluoroscope, and a few films are taken to confirm the appearance of the stomach and duodenum as seen. But these films are not to be considered diagnostic; the diagnosis is almost entirely made under the screen, and in most cases the films can only be interpreted accurately by the observer who made the fluoroscopic examination. Carman, who has developed and perfected this method, and who obtains a very high degree of accuracy in diagnosis—over 95 per cent.—gives the following signs of gastric and duodenal ulcer.

GASTRIC ULCER.

Direct signs.—(1) the niche, (2) the accessory pocket.

Indirect signs.—(1) Spastic manifestations: (*a*) incisura, (*b*) diffuse gastro-spasm; (2) retention from a six-hour meal; (3) alterations of peristalsis.

DUODENAL ULCER.

Direct signs.—(1) Deformity of the duodenal cap; (2) duodenal diverticulum.

Indirect signs.—(1) Hyperperistalsis; (2) retention from a six-hour meal.

Gastric Ulcer.—The niche is a bud-like projection from the stomach wall caused by barium filling the crater of an ulcer. It is most commonly seen on the posterior wall of the lesser curvature above the incisura angularis, a situation which Carman gives for 90 per cent. of gastric ulcers.

The accessory pocket is a further extension of the

niche. It denotes an ulcer which has eroded the gastric wall and has further extended by penetrating a neighbouring viscus, in which there is formed a diverticulum or accessory pocket bounded in part by the viscus and in part by perigastric adhesions. The viscera most commonly attacked in this way are the pancreas and liver, but ulcers have been found eroding the diaphragm and spleen and sometimes they perforate into the colon. The accessory pocket does not entirely fill with barium, but shows the barium shadow at its lower level, and above it is a bubble of air.

The incisura is an infolding of the greater curvature towards the lesser. It may be shallow, or so deep as almost to divide the stomach—when it may be called a spastic hour-glass. It is an indirect sign, but a valuable one when present and constant in position, and, if due to gastric ulcer, persists after a full dose of atropine. It often points to the situation of an ulcer on the lesser curvature. An incisura may also be present in a reflex dyspepsia from extra-gastric irritation, but is not so deep, and may be seen to move from one part of the stomach to another at the same or at a later examination. These incisuræ from irritation outside the stomach do not persist after atropine.

Diffuse gastro-spasm is general contraction of the stomach but most marked in the pyloric region, although the ulcer may be in any situation. The pylorus does not fill readily, and when made to fill by pressure shows a contracted outline somewhat like a snail's shell. This sign is not always present, but the pylorus may be seen to be contracted while the rest of the stomach is in a state of hypotonus.

Retention by the stomach of a large part of a barium meal given six hours before examination is an indirect sign of value in conjunction with other signs of gastric ulcer, since it occurs in about half the cases. Carman gives 55 per cent. It is found with gastric ulcers in all

situations, and does not necessarily indicate a pyloric ulcer.

Alterations of peristalsis are commonly present. The peristaltic waves may be weak or in excess of normal. They are frequently irregular, stopping short of the ulcer area, and re-commencing distal to it, and retro-peristalsis may sometimes be seen.

Duodenal Ulcer.—If the duodenum does not fill readily it can be made to fill by pressure of the hand on the greater curvature. The first portion or "cap" empties quickly so that observation must be rapid. It fills normally with each peristaltic wave, and it can readily be understood that a long series of films is necessary if a duodenal deformity is to be shown on several of them. Persistent deformity in outline of the duodenal cap was first recognized by Cole as a constant sign, and it almost invariably indicates duodenal ulcer, although adhesion to a chronically-inflamed gall-bladder may also cause deformity. Duodenal deformity persists even though the ulcer is healed.

The deformity may be a niche similar to that in gastric ulcer, or an incisura. Often the cap is completely deformed by multiple incisuræ, and sometimes it is contracted down and the lumen is stenosed.

Where there is an ulcer of the duodenum, the stomach always shows peristaltic waves in excess of normal, whether there is obstruction to the outflow or not. About three-fourths of cases show no obstruction and the remainder show varying degrees of retention of barium from a meal six hours previous to the examination. In extreme cases, almost all of the meal is retained, the stomach is large, peristalsis vigorous, and often it is difficult to force enough barium out of the stomach to fill the duodenum.

From the X-ray point of view the diagnosis of peptic ulcer is made on the fluoroscopic examination of the barium-filled stomach when examined in all positions,

palpated with the hand and the above points noted. The films which are taken will not show all the features, but in a general way they confirm the observations. Excluding the other organic lesions of the stomach—which have distinctive signs of their own—the radiologist has only to decide whether he is dealing with a peptic ulcer or not. The most likely error is in overlooking a small ulcer with few signs, and that error should never be so high as 10 per cent.

The radiologist is not concerned with half-measures, which only confuse the issue and mean nothing either to himself or to the physician. If he cannot see the signs of ulcer, the stomach and duodenum are, radiologically speaking, negative in this respect, a diagnosis which—when confidently given as it can be—is extremely valuable.

In the final review we look to the history and the X-ray examination for positive evidence, to the physical examination mostly for negative evidence. All the data so obtained must agree and fit in the picture before we can make a positive diagnosis of peptic ulcer. There are pitfalls ever open for us if we persist in making a diagnosis on the history or with the X-ray alone. For instance, a patient has "gastric symptoms" and the X-ray shows a deformity of the duodenum. He may have a duodenal ulcer, and he may not. He may have had a duodenal ulcer years ago, which had healed but left a permanent deformity. Subsequently he develops symptoms which, on careful analysis, are not symptoms of duodenal ulcer, but of reflex dyspepsia. His trouble may be anywhere but in the duodenum, and to perform a gastro-jejunostomy is but to add to the list of failures of that excellent operation.

The following case is illustrative :

A man complained of gastric symptoms and gave a typical history of peptic ulcer. He also had a urinary infection. But the X-ray examination was repeatedly negative, and the man was admitted to hospital for treatment of his urinary infection. As this cleared up,

so also did he lose his gastric symptoms. Now I still believe that this patient must have had some duodenitis, so typical was his history; but the picture was not complete, peptic ulcer was not diagnosed, and this was justified by the subsequent course of the case.

In a few cases—as, for instance, where the X-ray evidence is negative and the history contains some features suggesting ulcer—it is necessary to admit the patient under observation and prove up the doubtful points in the history by investigation.

When the final diagnosis is negative as regards ulcer, further steps must be taken to find out the condition from which the patient is suffering or the lesion which is giving rise to the gastric symptoms, but that is outside the scope of this article.

Many cases when diagnosed will come to operation, and it is the physician's duty and privilege always to be there. I know of nothing better calculated to develop the spirit of humility and the virtue of meticulous care in diagnosis than a practical demonstration of a mistake, if it should happen so to be. But apart from that, to see in the living body what we have deduced from symptoms and shadows is always to improve by a little our knowledge and to extend our education. It was so that knowledge began, and until we have attained the hundred per cent. of accuracy we must keep our minds open as students and always be willing to admit that we can learn something new.

SUMMARY.

Gastric and duodenal ulcers can be, and should be, diagnosed accurately and definitely in at least nine out of ten cases. Pre-operative diagnosis is safer, more accurate, and more economic than exploratory operation, and under no circumstances are we ever justified in advising or consenting to an operation on a patient with chronic abdominal symptoms unless a careful diagnosis and localization of the lesion has been made beforehand.

Practical Notes.

Results of Immunization against Tuberculosis.

A. Calmette publishes the latest results of his investigations on the immunization of infants against tuberculosis by the vaccine termed BCG (Bacillus Calmette-Guérin), in association with his collaborators of the Pasteur Institute and other colleagues. This immunization has been carried out in France on over 5,000 infants, as well as on smaller numbers in Belgium, Indo-China, and Senegal. Although in Europe as a whole the mortality from tuberculosis among infants of under a year in a household infected with tuberculosis is stated to be at least 25 per cent. (in Paris it is 32·6 per cent.), the mortality of the infants vaccinated with BCG was under 2 per cent. Professor Calmette has now been carrying on his observations for over five years, and believes that the efficacy of his method of immunization has been definitely proved. He recommends it especially for employment in families where the infants are exposed to the contact of persons suffering from tuberculosis.—(*Le Progrès Médical*, March 6, 1926, p. 384.)

Treatment of Pulmonary Tuberculosis with Sanocrysin.

T. R. Elliott describes his experience of sanocrysin, a drug lately introduced in Denmark for the treatment of tuberculosis. Sanocrysin is a very soluble thiosulphate of sodium and gold, containing 40 per cent. by weight of the latter metal; it is given intravenously as a solution in 10 c.cm. of water, in a dose of ½ grain, followed three or four days later by 1 grain. The general reaction that follows is not usually one of severe discomfort, but if the drug is pushed unduly there may suddenly develop alarming features, either of hyperpyrexia or of shock. There is, states Dr. Elliott, very real danger in an ill-regulated use of sanocrysin. Although he has treated only a small number of patients, he is of opinion that the treatment has seemed to coincide with a real improvement in each patient; he is in accord with Professor Faber, of Copenhagen, a physician of very wide clinical experience, who began the use of sanocrysin with perhaps a prejudice against it, but summed up his results in a statement that in it he found a drug that produced more rapid improvement in pulmonary tuberculosis than could be obtained by any other method of treatment that he knew.—(*Proceedings of the Royal Society of Medicine*, March, 1926, p. 53.)

Treatment of Leukæmia by Inoculation of Malaria.

T. Lucherini gives details of a case of leukæmia successfully treated by the inoculation of malaria, 3 c.cm. of blood from a malarial patient being injected subcutaneously. The case was that of a boy aged fourteen, his blood examination showing 250,000 leucocytes (73 per cent. myeloblasts), and 1,500,000 red blood

corpuscles, hæmoglobin 24 per cent. After twelve successive attacks of malaria he was treated with quinine, and a month later his blood examination showed leucocytes 5,800, red blood corpuscles 3,880,000, hæmoglobin 52 per cent., his general condition being greatly improved.—(*Il Policlinico*, December 14, 1925, p. 1745.)

The Value of the History in Tuberculosis.

M. H. Joress points out that a carefully taken history is of the utmost importance in arriving at a diagnosis in any disease, and particularly so in the diagnosis of tuberculosis. Many cases of tuberculosis may be diagnosed by the symptoms alone, and with but a small margin of error. A differential diagnosis should always be kept in mind. Symptoms of fatigue, loss of strength, persistent rise in temperature in the afternoon, and indigestion, should arouse our suspicions that the case will bear watching with a view to establishing a diagnosis of tuberculosis. A history of hæmoptysis should be considered tuberculous in origin until proved to be due to some other cause.—(*Boston Medical and Surgical Journal*, February 25, 1926, p. 344.)

Treatment of Pulmonary Emphysema.

In notes on the treatment of pulmonary emphysema the following formulæ are recommended :

℞ Liq. arsenicalis - - ♏ 36 (g. 2)
Aquam. destill. ad - - ℥vi (150 c.cm.)

Sig. One tablespoonful twice daily, after meals. This should be taken for a fortnight, and then the following given :

℞ Potass. iodid. - - ʒiss (g. 7·5)
Aquam. destill. - - ad. ℥vi (150 c.cm.)

Sig. One tablespoonful twice daily, after meals.

In case of an attack of bronchitis arising the following should be given :

℞ Ol. terpin. - - - } āā grs. iij (g. 0·2)
Sod. benzoat. - - }

Sig. Ft. cachet. Mitte tales xx. One to be taken every three hours.

Or, in case of an attack of asthma, the following :

℞ Extr. belladonn. - - gr. ⅙ (g. 0·01)

Sig. Ft. pil., mitte tales xx. One to be taken before meals and at bedtime.—(*Journal des Praticiens*, February 20, 1926, p. 121.)

Prevention of Ear Disease in Children.

Douglas Guthrie notes, in discussing middle-ear suppuration in children, that the prevention of inflammation of the ears has received more attention in France than in this country. Avoidance of colds in infancy is all-important. Adults suffering from colds should be isolated from their fellows, but especially from all contact

with infants. Colds in infants should be treated by mopping out nasal discharge and instilling 10 per cent. argyrol in glycerine—never menthol. At as early an age as possible the child should be taught how to blow the nose. Adenoids should be removed, but the surgeon's responsibility must not end with the operation; in all cases breathing exercises, and in many cases inflation of the ears by the Politzer method, are essential.—(*Edinburgh Medical Journal*, March, 1926, p. 50 [Supplement].)

Treatment of Scarlet Fever.

P. A. Bly agrees with Zingher that scarlet fever is a local disease of the naso-pharyngeal mucous membrane, caused by certain specific strains of the hæmolytic streptococcus, a soluble toxin being produced locally, which is absorbed into the system of the patient, giving rise to the skin and constitutional symptoms. In the treatment of scarlet fever Dr. Bly used, first, citrated convalescent blood, injected intramuscularly; and, later, pooled blood serum was substituted, first tested for sterility preserved with 0·3 per cent. of tricresol, and put up in 20 c.cm. portions. Following the injection of blood or serum the patient usually sleeps for several hours, and awakens greatly improved. Since 1924 Dochez serum has been employed, which appeared to bring about a more rapid improvement in the symptoms of the toxæmia. Every patient is kept in bed for twenty-one days, and in the absence of renal involvement the drinking of generous amounts of water is urged. Frequent washing out of the lower bowel with normal saline solution is of distinct benefit, and when the angina is severe the necessary amount of water may be introduced in this way. Attention to the throat and naso-pharynx decreases the incidence of middle-ear involvement; the naso-pharynx is gently flushed out and the fauces painted with 20 per cent. argyrol solution six or eight times daily.—(*New York State Journal of Medicine*, April 1, 1926, p. 309.)

The Influence of Rest, Sleep and Work on the Heart.

L. Kanner states that with the increased pulse-rate after work there is a corresponding increased time of action; with the diminished pulse-rate in the condition of waking rest and during sleep there is a corresponding diminished time of action. Regarding time of action and time of electric stimulation, there is no difference between sleepless rest and sleep. Uneasy sleep with exciting dreams results in an increased pulse-rate with prolonged time of action. There is an alteration in the relation between the time of mechanical action and the time of electric stimulation under the influence of rest, sleep, and work. In arrhythmias the difference in time between the single heat-periods is increased during rest, diminished under the influence of work. Extra-systoles which had disappeared after digitalis medication reappeared during work. Age, sex, and blood-pressure had no influence upon the conditions described.—(*American Journal of the Medical Sciences*, March, 1926, p. 648.)

Reviews of Books.

Taylor's Practice of Medicine. By E. P. POULTON, M.A., M.D., F.R.C.P., with the assistance of C. PUTNAM SYMONDS, M.A., M.D., F.R.C.P., and H. W. BARBER, M.A., M.B., F.R.C.P. Pp. 1063. Thirteenth Edition. With 48 Plates and 93 Text-figures. London: J. and A. Churchill. 28s. net.

THE thirteenth edition of this well-known text-book of medicine should prove to be more popular with general practitioners than most similar text-books by reason of the number and the excellence of the illustrations, particularly the many radiograms and the coloured plates of common skin diseases. Although the twelfth edition appeared only three years ago, this new edition has been revised throughout, and has been brought thoroughly up-to-date, even Gye and Barnard's work on the etiology of malignant neoplasms receiving due mention in an admirably succinct appendix. At the end of each section there is a full list of references to recent medical literature.

A Text-book of the Practice of Medicine. By various Authors. Edited by FREDERICK W. PRICE, M.D., F.R.S.E. Pp. 1828. Second Edition. London: Humphrey Milford, Oxford University Press. 35s. net.

THE success of this text-book of medicine with medical students and practitioners is shown by the fact that in three years five impressions have been exhausted, and a new and revised edition is now published. The new material added includes the Schick and Dick tests, quinidine therapy, the pathology of auricular fibrillation, the mental sequelæ of encephalitis lethargica, etc. Dr. Price has been fortunate in his collaborators, and the book avoids the unevenness which a large number of contributors too often brings about. The different sections are more than adequately covered, and the reader cannot but be struck particularly by the brilliant success of the section devoted to diseases of the nervous system.

Traumatic Injuries of the Carpus. By KELLOGG SPEED, M.D., F.A.C.S. Pp. 197. Illustrations 164. London and New York: D. Appleton & Co. 21s. net.

THIS monograph is written in a scholarly and easy style, and the subject matter is critical and discriminating. In fact, we have read the book with much pleasure and profit, and it will serve as a standard work of reference on an intricate and difficult subject. In the book there is a lucid and thorough description of Colles' fracture and its complications, and a clear account of the degenerative changes which take place in fractured carpal bones in a certain proportion of cases; this fact constitutes a strong plea for their early, but not necessarily immediate, removal. The illustrations are clear and good, and add very much to the value of the work.

GENERAL INDEX

TO VOLUME CXVI.

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